MODERNISATION OF SCIENCE POLICY AND MANAGEMENT APPROACHES IN CENTRAL AND SOUTH EAST EUROPE

NATO Science Series

A series presenting the results of scientific meetings supported under the NATO Science Programme.

The series is published by IOS Press and Springer Science and Business Media in conjunction with the NATO Public Diplomacy Division.

Sub-Series

I.	Life and Behavioural Sciences	IOS Press
II.	Mathematics, Physics and Chemistry	Springer Science and Business Media
III.	Computer and Systems Sciences	IOS Press
IV.	Earth and Environmental Sciences	Springer Science and Business Media
V.	Science and Technology Policy	IOS Press

The NATO Science Series continues the series of books published formerly as the NATO ASI Series.

The NATO Science Programme offers support for collaboration in civil science between scientists of countries of the Euro-Atlantic Partnership Council. The types of scientific meeting generally supported are "Advanced Study Institutes" and "Advanced Research Workshops", although other types of meeting are supported from time to time. The NATO Science Series collects together the results of these meetings. The meetings are co-organized by scientists from NATO countries and scientists from NATO's Partner countries – countries of the CIS and Central and Eastern Europe.

Advanced Study Institutes are high-level tutorial courses offering in-depth study of latest advances in a field.
Advanced Research Workshops are expert meetings aimed at critical assessment of a field, and identification of directions for future action.

As a consequence of the restructuring of the NATO Science Programme in 1999, the NATO Science Series has been re-organized and there are currently five sub-series as noted above. Please consult the following web sites for information on previous volumes published in the series, as well as details of earlier sub-series:

http://www.nato.int/science
http://www.springeronline.nl
http://www.iospress.nl
http://www.wtv-books.de/nato_pco.htm

Series V: Science and Technology Policy - Vol. 48 ISSN: 1387-6708

Modernisation of Science Policy and Management Approaches in Central and South East Europe

Edited by

Edvard Kobal

Slovenian Science Foundation, Ljubljana, Slovenia

and

Slavo Radosevic

School of Slavonic and East European Studies, University College London, United Kingdom

IOS Press

Amsterdam • Berlin • Oxford • Tokyo • Washington, DC

Published in cooperation with NATO Public Diplomacy Division

Proceedings of the NATO Advanced Training Course on Modernisation of Science Policy and Management Approaches in Central and South East Europe
Ljubljana, Slovenia
28–29 November 2003

ISBN 1-58603-517-7
Library of Congress Control Number: 2005925128

Publisher
IOS Press
Nieuwe Hemweg 6B
1013 BG Amsterdam
Netherlands
fax: +31 20 620 3419
e-mail: order@iospress.nl

Distributor in the UK and Ireland
IOS Press/Lavis Marketing
73 Lime Walk
Headington
Oxford OX3 7AD
England
fax: +44 1865 750079

Distributor in the USA and Canada
IOS Press, Inc.
4502 Rachael Manor Drive
Fairfax, VA 22032
USA
fax: +1 703 323 3668
e-mail: iosbooks@iospress.com

PRINTED IN THE NETHERLANDS

E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

Preface

This book is a result of the joint efforts of a majority of the participants in the NATO Advanced Training Course (ATC) "Modernisation of Science Management Approaches in Central and South East Europe" that was held on 28 and 29 November 2003 in Ljubljana, the capital of Slovenia. The event was organised by the Slovenian Science Foundation and was attended by 45 participants from thirteen European countries and the USA. The speakers were from NATO countries (Germany, Greece, Hungary, Great Britain and USA) and Slovenia (which became a member in March 2004). The trainees were from the South East (Albania, Bosnia and Herzegovina, Bulgaria, the Former Yugoslav Republic of Macedonia, Romania, Serbia and Montenegro and Croatia) and Central European countries (Hungary, Slovakia and Slovenia).

The motivation of the NATO ATC was to provide intensive training of public administrators (e.g. state secretaries, state under-secretaries, government counsellors and experts in science and technology policy) working at the ministries responsible for science and technology in South East European countries. Some of these countries, particularly the ones facing political and economic crises, are still not integrated into the international community. Furthermore, their scientific communities have not been able to seize the opportunities offered to them on the international level. This has often been the consequence of the fact that R&D is not supported by efficient science policies. Their social and historical frameworks prevented public administrators from acquiring adequate skills that would enable them to become active participants in the international science and technology community. In addition, many of the South East European (SEE) countries have not been able to develop modern management approaches in science. As a result, national scientific communities often do not have the support and information that they need to become integral and active players in the international arena. Without modern management strategies, these countries will not be able to use all of their intellectual and other resources, which are an essential part of economic development.

The NATO ATC helped public administrators to acquire the knowledge and skills needed to overcome some of the problems facing them in science policy management. The trainees of the course got deeper insight into the skills and knowledge needed for the successful development and constitution of national research programmes, for the development and support of international science and technology co-operation and for science management.

The articles in this book are based on the presentations given by participants of the course. We have also included a few studies (Chapters 1–3) that additionally illuminate the situation in Central and South East Europe (knowledge-based economy and society, elements of national science and technology policy). Moreover, a few special contributions from the Central and South East European participants provide additional information for people who work in science management and strive to internationalise the field of science. As a result, this volume provides a comprehensive overview of S&T policies in SEE countries for the first time and brings these countries into comparative perspective with Central

European and other EU countries. In addition, the volume contains analysis of several important science policy issues (human resource management, management of quality and finance, peer review and networking); in this respect, the volume will be of interest to a wider audience interested in S&T policy-making in general.

Edvard Kobal and Slavo Radosevic
Ljubljana and London, September 2004

Acknowledgements

We would like to give thanks to everyone who assisted us in organising the NATO ATC, as well as to those who helped us prepare this book. The book is a result of the collective effort of a large number of experts in science and technology (innovation) policy, high-ranking representatives of the government ministries responsible for science and technology in Central and South East European countries, and experienced practitioners in science management, among them Maja Bučar, Boris Cizelj, Dimitris Deniozos, Nada Švob-Đokić, József Imre, Miloš Komac, Đuro Kutlača, Zoltán Peredy, Zoran T. Popovski, Janez Slak, Milanka Slavova, Viktor Stefov, Lamija Tanović, Andrea Vass, and Guenter H. Walter.

The NATO dimension of the scientific event (ATC) gave us the opportunity to include experts from the USA, such as Professor Paul Rambaut (University of Hawaii), Dr. Norman P. Neureiter (US Department of State, Washington, D.C.), and Dr. Larry Secrest (Secrest & Co., Austin, Texas) into the preparation and implementation of the ATC.

We would also like to give special thanks to the NATO Science Programme for financially supporting the implementation of the ATC, as well as for providing the grant to publish this book. Sincere thanks also to the Ministry of Education, Science and Sport of the Republic of Slovenia for its financial support, as well as to Dr. Zoran Stančič, State Secretary for Science, Republic of Slovenia, for his understanding and help.

Not least, we would like to express our thanks and gratitude to Darja Čot, Head of International Science Co-operation, Slovenian Science Foundation, for her work during the preparation and implementation of the ATC and this book.

Sincere thanks also to Mojca Zupančič and Barbara Papež, both of the Slovenian Science Foundation, for their assistance.

Introduction

Science and technology have a paramount role in a knowledge-based society. Scientific knowledge is a form of capital and a factor in development. Strategies for its extension as a background for innovation capacities, and strategies for widespread access skills, are mandatory in the transition to a knowledge-based society. Scientific knowledge can be developed to the full only if it is supported by effective and modern science policy.

South East European countries need professional support in the form of training, as well as improving and exchanging the principles of good practice, with the aim of providing them with sufficient skills to participate efficiently in creating and implementing a common scientific policy, particularly in Europe. Providing such training is very important, since most of these countries have not been able to participate in programmes of the European Union Directorate General for Research (DG Research) (applied research and development) or European Science Foundation (basic research). The 6th Framework Programme of the European Union gives so-called “third countries” (where the SEE countries also belong) the opportunity to participate. This gives the ministries responsible for science and technology in South East European countries the opportunity to co-operate in these programmes and to open their scientific communities to the international arena. Furthermore, it gives them the opportunity to establish efficient and well-qualified administrative bodies and to adopt strategies that will follow the (scientific) strategic goals of the European Union or other developed countries in the world. This will also positively influence development of their co-operation in the NATO science programmes.

It is generally known that – compared to the USA and Japan – connections between research and the application of knowledge are relatively weak in Europe despite extensive scientific research work. This so-called “European Paradox” is true for some EU countries and, especially, for South East European countries. The large deficit is evidenced by the small, or practically nil, market success in technologically demanding areas. European awareness regarding this deficit in the area of research and development is reflected in efforts to form and implement efficient technology or innovation policies. The essence of these policies is the need to plan and implement research and development in the framework of close co-operation between business enterprises and universities and research institutes, to disseminate and optimise the results of research and development activity, and to encourage mobility of researchers and their education and training. The essential elements of these policies are quality education and human resources.

This volume brings a wealth of scholarship on S&T policy, in particular on the countries of South East and Central Europe.

Dr. Edvard Kobal sets the broad scene for S&T policy-making today by first outlining the historical legacy of these economies and how it affects their transformation into knowledge-based societies (Chapter 1). He then highlights the key policy issues entailed in the transformation to a knowledge-based economy (Chapter 2) and continues by specifically discussing the elements of national S&T policies that are conducive to this transformation (Chapter 3).

The shift toward modern approaches in S&T policy is by no means an easy and trivial exercise. The chapter by Prof. Đuro Kutlača is an excellent case of how the transfer of R&D priorities model faces a variety of difficulties when there is a change of context. In this respect, its conclusions are quite sobering and show the often forgotten, deeply political nature of S&T policy.

Dr. Slavo Radosevic reviews the transformation of research and technology policies in new EU member and candidate states, which are a natural reference point for many South East European countries. He points to the excessively R&D/high-tech oriented nature of their policies, which neglect other elements of innovation capacity that are related to firm-level efforts and productivity improvements. He also points to problems in embracing and integrating FDI into innovation policy. These lessons are of high relevance for SEE countries.

Part 2 represents an overview of the S&T policies of all South East European countries, except Albania, and the Central European countries of Slovenia and Hungary. In itself, this is valuable review as it shows how geographically very close S&T systems have developed to very different degrees. The rich material that is presented clearly points to areas of international cooperation in S&T policy and to great opportunities for trans-national policy learning. We believe that this overview will be of substantial help to international organisations like the European Science Foundation, EU, or World Bank when designing regional programs that address S&T capabilities. In this part, Dr. Guenter Walter summarises regional technology policy issues based on his rich consultancy and research experience in the counties of Central and Eastern Europe. Regional innovation policy has become increasingly important for new member states, and we hope that candidate and other SEE countries will draw valuable lessons from past experiences in this area.

Part 3 focuses in depth on several issues in science management. Croatian and Slovenian experiences in human resource management are quite interesting and are well analysed in the contributions by Dr Nada Švob-Đokić, Dr Miloš Komac and Marjanca Bertoncelj. Chapter 16 summarises brainstorming sessions at the NATO ATC, which involved all participants and contain a wealth of know-how for all those involved in issues of finance and quality in R&D. Dr. Paul Rambaut brings a variety of national and international perspectives on peer review; in this respect, it is a highly instructive contribution of great relevance for countries whose peer review systems suffer from endemic failures typical of small and poor R&D systems. Dr. Boris Cizelj analyses highly successful Slovenian experiences in interests representation, networking and lobbying in S&T. As the international dimension of S&T policy has become the most important dimension for new member and candidate countries, his experiences and lessons are highly instructive not only for these countries but also for other SEE countries aspiring to EU membership and increased international integration in S&T.

The concluding chapter draws on the rich material that has been accumulated in the previous chapter and tries to provide analytical and policy synthesis. As such, it is aimed at donor and other international organisations oriented towards the SEE region. Also, we hope that its message will be highly instructive for policy-makers in all of the SEE countries as well as of relevance to scholars in S&T policy in general.

Edvard Kobal and Slavo Radosevic
Ljubljana and London, September 2004

Welcoming Remarks and Introduction to NATO Science Programmes

Dr. Paul RAMBAUT
Member of the NATO Advisory Panel on Science and Technology Policy

Abstract. Participants were welcomed to the Advanced Training Course and were provided with a brief description of NATO's Programme for Security through Science.

Welcoming Remarks

Chairmen, Mr. State Secretary, Ladies and Gentlemen.

I would like to welcome you on behalf of NATO and, in particular, of Prof. Fernando Carvalho Rodrigues, who is the NATO manager of the programme on Science and Technology Policy. I am sure that Prof. Rodrigues would be very pleased with the way this ATC has been organized and that he would agree when I say that it reflects the best traditions of NATO-sponsored scientific activities.

This meeting has evolved from an initial suggestion made by the State Secretary to Prof. Rodrigues. The NATO Advisory Panel on Science and Technology Policy considered Dr. Zoran Stančič's suggestion to be particularly promising and constructive. Following encouragement by NATO, the staff of the Slovenian Science Foundation, under the able leadership of Dr. Edvard Kobal, developed a detailed proposal that met all of NATO's specifications.

Dr. Kobal was also able to persuade Prof. Slavo Radosevic of University College, London to be co-director for the course along with himself. This leadership, shared between NATO-member and NATO-Partner countries is an essential requirement for NATO sponsorship.

I am particularly grateful to Mrs. Darja Cot of the Slovenian Science Foundation, with whom I was in frequent e-mail contact, for tending to the details of the proposal and for overseeing the complex logistical arrangements that followed its approval.

I am particularly impressed with the level and skill of both the specialists and trainees who have assembled here. I am convinced that their interactions will be very productive and will lay the groundwork for similar activities in the future.

Finally, I would like to thank the Ministry of Education, Science and Sport of the Republic of Slovenia as well as the Slovenian Science Foundation for the hospitality and enthusiasm with which they have welcomed the representatives of so many nations.

1. NATO Science Programmes

1.1. Historical Background

NATO's Science Programme, or as it has been recently renamed, its Programme for Security through Science, is administered by the Division of Public Diplomacy at NATO Headquarters in Brussels.

Earlier this month, NATO announced that its Science Programme had changed course. Since I was a manager of the more traditional Science Programme, I will try to put this new course into an historical perspective.

The NATO Science Programme has always dealt with international collaboration in science and the environment. It forms an important part of NATO's Third Dimension – a dimension based on Article 2 of the North Atlantic Treaty and founded on the premise that stability among nations can be achieved by enhancing their overall well-being. NATO's other two dimensions are, of course, political and military.

The Third Dimension, or non-military dimension, was established following a 1957 report called the "Report of the Committee of Three" (Mr. Halvard Lange of Norway, Prof. Gaetano Martino of Italy and Mr. Lester Pearson of Canada). The need for enhancing science in the NATO Alliance was prompted by the dramatic launch of Sputnik in 1957 and the accompanying concern that scientific advancement and scientific training within NATO nations might be falling behind those of the Soviet Union.

NATO's Third Dimension activities began with the creation of a NATO Science Committee in 1958 and, ten years later, by the creation of a Committee on the Challenges of Modern Society, to deal mainly with environmental issues.

At the first meeting of the Science Committee, in March 1958, representatives from thirteen of the fifteen NATO countries met at the Palais de Chaillot in Paris and mapped out a programme that was eventually to become renowned throughout the world for its scientific excellence. The programme has proved to be adaptable and resilient in the face of many challenges that could not have been foreseen.

1.2. Objectives of the Programme

The objectives of the NATO Science Programme have changed several times over the years.

At the outset, in 1957, its purpose was to promote scientific collaboration and education within the NATO Alliance by encouraging the mobility of researchers and the exchange of knowledge.

In 1991, following the dissolution of the Warsaw Treaty Organization, the NATO Science Programme was enlarged to include NATO Partner countries. Its purpose was thus expanded from not only promoting scientific collaboration within the Alliance but also to creating links with scientists in Partner countries.

In 1999, the Programme was changed once again to concentrate exclusively on links between NATO and Partner countries. The programme endeavored to stabilize the scientific communities in Partner countries by enhancing their interactions with the international scientific community.

1.3. Programme Activities

In its focus on NATO-Partner Country cooperation, the NATO Science Programme remained exclusively funded by NATO. It utilized a series of funding mechanisms that are still in use today. These include projects, conferences, fellowships, training courses, computer networks and expert visits.

Through these various mechanisms, about 10,000 scientists participate each year in the NATO Science Programme. In 2001, over 6000 scientists took part in over 100 NATO scientific meetings and about 100 volumes of proceedings were published. Since 1999, over 2,500 fellowships have been awarded to Partner Country scientists.

Besides the activities overseen by NATO's Science Committee, there are those overseen by the Committee on the Challenges of Modern Society. The activities of this committee, which are largely the result of direct intergovernmental cooperation, are funded directly from national sources.

The Committee on the Challenges of Modern Society provides a forum for an exchange of views mainly on environmental issues and, in particular, those that are defense-related. Under the auspices of this Committee, 68 long-term pilot studies and seven short-term projects have been completed. There are, at present, 15 ongoing pilot studies and four short-term projects. In total, over 270 publications have resulted from this programme.

1.4. New Directions

In October 2003, a new concept for NATO's support of civil science was agreed upon by the North Atlantic Council following proposals put forward by the NATO Science Committee at its meeting in Kyiv, Ukraine in June of 2003.

To emphasize the new direction, it was decided that the Programme would henceforth be known as the NATO Programme for Security through Science.

The advertised aim of the new programme is to contribute to security, stability and solidarity among nations by applying cutting-edge science to problem solving and to accomplish this through collaboration, networking and capacity-building. It was also foreseen that the programme would help to catalyze democratic reform and support economic development in Partner countries.

A feature of the new programme is to move away from bringing scientists together primarily to foster partnerships within an extended scientific community. In a world changed by the terrorist attacks of 11 September 2001, the programme will now bring scientists together to work on solving problems associated with security issues of concern to NATO, NATO-Partner and Mediterranean Dialogue countries.

In 2004, NATO's familiar Advisory Panels, which are drawn from the scientific community, will continue to peer review applications grouped into Environmental and Earth Sciences, Life Sciences, Physical Sciences, and Security-Related Science and Technology. However, support will no longer be available for all areas of science. Only applications in certain priority research topics, or in priority areas identified by Partner countries, will be considered.

1.5. Priority Research Topics

The list of priority research topics is as follows:

- Scientific Collaboration for Defense against Terrorism. The priority research topics in this area are concerned with the science involved in, for example, detecting chemical, biological, radiological or nuclear weapons or agents, or in protecting populations against such weapons, along with improved decontamination procedures and improved methods to destroy these types of weapons or agents. The priority area topics also include the medical responses needed to counteract such weapons, such as, for example, chemical and vaccine technologies. Measures to protect against eco-terrorism and computer terrorism are two additional areas earmarked for concentrated study.

- Scientific Collaboration to Counter other Threats to Security. Although the topics included in this second category are in less obviously dangerous fields, they nevertheless pose a risk to security and stability, particularly in a regional context. One such topic is environmental security where, for example, desertification, land erosion and pollution of common waterways can lead to regional or cross-border disputes. Water resources management or management of other, non-renewable, resources are two more examples of problems of special interest. Scientific models of sustainable consumption are solicited under this priority area.
- Technology Transfer to Address Partner Country Priorities. Among the priority research topics will be those specially selected by Partner countries. A process of consultation with Partner countries through the EAPC Science Committee has begun and a list will shortly be drawn up of the priority areas identified by Partner countries. Scientists from these countries will be able to propose collaboration with NATO-country colleagues either in the priorities of their own countries or in the above priority topics in Defense against Terrorism or Countering other Threats to Security. Applications that fall within both the NATO Priority Research Topics and Partner-country priorities are particularly solicited.

2. Practical Aspects of the Programme

The NATO Programme for Security through Science therefore offers support for international collaboration between scientists in countries of the Euro-Atlantic Partnership Council or the Mediterranean Dialogue. Awards are made following the consideration of applications received from individual scientists in these countries.

The support funded under the programme is channeled through a range of different mechanisms, including:

- Collaborative Linkage Grants
- Expert Visits
- Advanced Study Institutes
- Advanced Research Workshops
- "Science for Peace" R&D projects
- Computer Networking Support

In addition, a limited number of fellowships are available.

3. Management

The restructuring of the international staff at NATO Headquarters, which began following decisions taken at the Prague summit in November 2002, is now complete. The restructuring included a merger of the Scientific and Environmental Affairs Division with the Office of Information and Press to form a new Public Diplomacy Division. Mr. Jean Fournet, formerly Assistant Secretary General for Scientific and Environmental Affairs, became Assistant Secretary General for Public Diplomacy, with overall responsibility for the new Division. There are two Deputy Assistant Secretaries General, one in charge of External Relations (Dr. Jamie Shea) and one in charge of Science Cooperation (Dr. Keith Gardner).

As in the past, overall policy guidance for the new NATO Programme for Security through Science will be provided by the NATO Science Committee, which is composed of representatives of each NATO member country. The Science Committee normally meets three times a year. One of the meetings is in a so-called Euro-Atlantic Partnership Council or EAPC format, in which the 19 NATO-country representatives are joined by colleagues representing 27 Partner countries. The Science Committee also meets twice a year in the format of the NATO-Russia Council.

The Science Committee is assisted in its work of assessing and selecting applications for support by advisory panels whose members are selected by the Science Committee from among the international scientific community. Associate members from Partner countries and Mediterranean Dialogue countries also serve on the Advisory Panels. This direct involvement of the scientific community has been invaluable for maintaining the high scientific standard of the Programme.

4. Conclusion

In concluding, I should point out that Slovenia has been an active participant in the NATO Science Programme and she is expected, likewise, to contribute substantially to the new NATO Security through Science Programme.

In only one NATO programme I can point out that, of the 125 Science for Peace projects underway in Partner countries, six have had Slovenian co-directors and about 5% of the available funding has gone to Slovenia. This has amounted to €960,000 as of April 2003.

In the future, there is every hope that Slovenia will continue to contribute substantially to the new NATO Security through Science Programme.

For its part, NATO will continue to offer effective mechanisms for Alliance and NATO-Partner cooperation and this cooperation will be focused on topics of common interest.

Thank you.

Contents

PART I

Issues in Science and Technology Policy

This page intentionally left blank

Modernisation of Science Policy and Management Approaches in Central and South East Europe
E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 1

From Central Planned Economy to Knowledge-Based Society

Dr. Edvard KOBAL
Slovenian Science Foundation, Ljubljana, Slovenia

Abstract. The establishment of a suitable institutional environment for comprehensive functioning of a market economy in the transition countries was one of the most important and complex matters in the 1990s. The central planned (socialist) economies of Central and Eastern Europe differed from Western market economies particularly in the matter of defining markets and the roles of the state and the financial system. For the development of a well-functioning market economy, it is characteristic to emphasize: the development of banks and financial markets; the fiscal environment; private property rights and contracts; labour market institutions; institutions dealing with competition policy, industrial policy and trade policy; and trust between economic agents and the honesty of public institutions.

To establish a knowledge-based economy and society, it is important to create and strengthen the connections between knowledge sources and business enterprises. Weak connections hinder the attainment of a successful level of this kind of economy. Different means of regulation, upgrading political-bureaucratic hierarchical intervention, and a sufficient quantity of social capital are also needed.

The fall of the Berlin Wall in 1989 resulted in several political and socio-economic changes in the countries of Central and Eastern Europe and in some countries of the former Soviet Union. Making the transition from central planned (socialist) economy to market economy was the most important and crucial decision [5] adopted by countries that have already been functioning in the last few decades of the 20th century along with newly formed ones, among them also Slovenia. This decision required a number of structural and institutional reforms and the selection of appropriate methods, for instance the selection between “shock therapy” or “gradualist approach”. In the case of new countries, it was necessary to attain macroeconomic stability and internal and external liberalisation. The structural and institutional reforms also included: setting up institutions; privatising state-owned assets; and reforming the business sector, financial sector, tax and pensions system, social welfare sector, public utilities and public administration [3].

It is very important for countries in transition to chose the correct pace of transition and change from distorted prices to market prices. It is also important to stay pragmatic regarding the attraction of foreign companies into the country to participate in joint ventures, as well as the adoption of recommendations given by international organizations, such as the International Monetary Fund (IMF) and the World Bank. In the process of making the transition from a socialist economy to a market economy, the IMF engaged itself especially in matters of macroeconomics, and the World Bank in the area of structural reform. In the 1990s, during the process of candidate countries' accession, the European Commission got involved. Hence, the fall of the Berlin Wall brought a new role to the international community and its institutions.

In the beginning of the 21st century, we can also see joint actions. For instance, in February 2002, The World Bank in co-operation with the European Commission, the Organization for Economic Co-operation and Development, the European Bank for Reconstruction and Development, and the European Investment Bank organized the Knowledge Economy Forum "Using Knowledge for Development in EU Accession Countries". The goal of the Forum was to move beyond general discussion of the knowledge-based economy to a specific and practical understanding of how the global trend toward knowledge-based economies affected the accession countries, how they could respond in practical ways to the challenges posed by this trend, and how their specific institutional and economic legacies shaped their efforts to respond [6].

National reform strategies demanded the preparation of key developmental documents. In EU candidate countries, this was the strategy for accession to the European Union. The concepts and contents of these strategies were fully endorsed by the European Union as well as by the major international financial institutions.

According to the opinions of some top economists, whose points of view and beliefs are close to the World Bank's, the increasing gap in technological progress was the main reason for the change of central planned economies in some former socialist countries of Central and Eastern Europe and in the Soviet Union, as well as the for the breakdown of the Soviet bloc. At the end of the 1980s, the process of the transition from socialist economies to market economies had begun. The process of democratisation of national societies and orientation toward the European Union, as a desired option for the future of these societies, had also started.

The decision to access and integrate the countries of Central Europe and the Baltic region has been important not only for these European sub-regions, but also for the European Union. The accession of ten countries into the EU in 2004 – half of them from Central Europe – represents a great challenge to the European Union, especially for reformation of its institutions and further democratisation.

It was at the end of the 20th century, at the Lisbon Summit (March 2000), that the European Union probably became the most fully aware of the globalisation that it was facing. It became cognizant of the necessity of efficient functioning of the economic, political and social institutions that, while functioning on the pan-European level, enable the competitiveness of its economy. Europe "would become during the next decade the most competitive and dynamic knowledge-based economy in the world" [2]. Processes that took place in the candidate countries during the end of the 20th century and the first years of the 21st century have been recognized, acknowledged and, we can also say, rewarded by membership in the European Union in 2004. Hence, a few years before formal membership, the candidate countries started the second phase of transition by developing knowledge-based societies and, in the framework of these, knowledge-based economies. Relatively successfully implemented transition processes, absorbed shocks of transition and the de facto membership of candidate countries in the European Union in 2004 also act as an encouragement to other countries, especially in South East Europe, that want to attain the goals that have already been reached by some of the countries in Central Europe (Slovenia, Hungary, the Czech Republic, Slovakia and Poland).

The common goals of the European Union are reflected in a heightened awareness of how acquiring and using knowledge is increasingly becoming a key factor in determining the competitiveness of a national economy. A knowledge-based economy of course demands a coherent and proactive strategy according to the individual country. The problems that institutions and influential groups are facing are the result of the "legacy of past decades". This was shown in the transition period of the 1990s in the form of relatively large political and economic problems, even in countries that were expected to make the transition without such difficulties, such as the Czech Republic and Poland. New problems can also be predicted in implementing the mandate of the Barcelona Summit (2002) "that research and technology development (RTD) investment in the European Union must be increased with the aim of approaching 3% of GDP by 2010" [2]. It also called for an increase in the level of business sector funding, which should rise from its current level of 56% to two-thirds of total RTD investment, a proportion already achieved in only a few European countries.

During the process of changing national economies into knowledge-based economies, the new members of the enlarged European Union (and countries wishing to become members during the next enlargement process) cannot copy the successful examples of transition, such as Ireland and Finland. However, they can consider the human and intellectual, as well as the cultural and social, capital of their countries. It is necessary that transition programmes consider all types of available capital when creating the conditions for knowledge-based economies and when defining the key opportunities and priority fields of functioning of the state or broader community, such as the European Union. Of course, it is of vital importance to also identify how the international community can help the new member and candidate countries address these challenges and opportunities [4].

The knowledge revolution brings along new opportunities as well as risks. Industrialized countries are distinguished not only by higher incomes per capita, but also by more advanced knowledge and technology, while developing countries lag further behind. In between are the transition economies of East Central Europe and the former Soviet Union. These countries are able to adapt basic knowledge and technology imported from abroad to varying degrees, but they are much less able to innovate and produce the cutting-edge knowledge needed for rapid development [4].

The new members of the European Union from Central Europe, and potential candidates from the countries of South East Europe, have opportunities particularly in the area of education reform, in increasing the number of citizens with the academic titles "Master of Science" and "Doctor of Science", and in strengthening links between knowledge sources (universities, research institutes) and business enterprises. Of course, the public administration cannot leave certain matters only to the market, since it would be otherwise practically impossible to expect the suitable structure of knowledge and expertise that will become the subject of market demand in the next few years.

The focal point for shrinking the gap in technological progress is the greater use of knowledge and the transfer of technology. Science and key technologies (information communication, biotechnology, nanotechnology and others) enable the transformation of low-income economies to middle-income (and some even to high-income) economies. Of course, investments in education and in creation of a critical mass of researchers in priority fields or research and development and in research and experimental development are necessary. The development of the capacity for the absorption and use of knowledge and the capability to innovate are also very important.

The decision for a knowledge-based society demands the development of a national strategy for building and sustaining a knowledge-based economy and society. It is necessary to: create a society of skilled, flexible and creative people; build a dynamic information infrastructure; create appropriate economic incentive and institutional regimes; and create an efficient innovation system.

For attaining knowledge, it is necessary to activate different forms of education and learning. It is essential to put lifelong and permanent learning in the forefront and enable formal, as well as informal, methods of learning.

The creation of an information communication infrastructure requires the implementation of several measures, from fostering a computer infrastructure to creating information-based production processes. The attainment of maximum computer literacy and the ability to use other products of information communication technology are also in the forefront.

Fostering the efficient use of knowledge in all economic sectors should also be in the forefront. The use of knowledge advances the private sector, which is, in addition to the knowledge-based society, a main generator of change. From this element of national strategy originates also the fourth element, which is composed of the mechanisms and means for transferring knowledge and fostering and implementing the different types of innovations that are included in the national innovation system.

The presented elements are of key importance for the strategy. They reflect a complex and demanding process called cognitive mobilization.

Different indicators are used to evaluate cognitive mobilization in a specific country. We use them to rank the country's development and its closeness to the developmental core, e.g. the European Union. The high accumulation of knowledge and production of new knowledge is the result of the fact that a satisfactory segment of the population has completed tertiary education. At the same time, we must have information on how much public money is spent on tertiary education. The expansion of education, especially tertiary, indicates that a consensus on the importance of knowledge has been developing. This can be also confirmed by the share of GDP that a state allocates for tertiary education. This share can, when compared to other countries, indicate that an individual country is falling behind. The self-paid (private) funding of irregular study must also be considered, but it does not contribute to creating cognitive mobilization [1].

It is also essential to consider the level of development of informal education. If this type of education is not developed enough, as is the case in most South East European countries, then it is unrealistic to expect strong support for implementation of a knowledge-based economy and society. To this we can add the influence of formal study and its relation to informal education.

To establish a knowledge-based economy and society, it is important to create and strengthen the connections between knowledge sources and business enterprises. Weak connections hinder the attainment of a successful level of this kind of economy. Different means of regulation, upgrading political-bureaucratic hierarchical intervention, and a sufficient quantity of social capital are also needed.

The management of production, dissemination and application of knowledge must be based on national science, education and technology policies. The definition of these policies and control over their implementation is very essential. It is necessary to follow the results and make needed changes. At the same time, the role of individual factors must also be monitored.

National policies are in sync with global, strategic developmental needs, which are defined primarily by the most economically developed countries of the world, with the USA leading. Hence, it is understandable that in Central and South East Europe, national policies in the field of science, education and economic development contain mostly the same strategic goals and, in part, strategies. They must contribute to the priority decision-making of the state, business and third sectors on the national and, in the case of the European Union, pan-national level.

If they want to utilize their developmental opportunities and available potential and change them into a competitive advantage, it is necessary for contemporary societies to use all available sources of capital for their development. Strategic cooperation cannot be encouraged only on the basis of hierarchical state intervention, which was very typical for socialist systems in the countries of Central and South East Europe. There is a need for the ability to create new teams and business enterprises along with civil society organizations that are based on mutual trust and joint long-term goals.

On the level of new political and policy-creation systems, new mezzo-policies (governance) arise that include: experts from universities and research institutions; representatives of private foundations for the promotion and enhancement of public-private partnerships; and members of other non-governmental organizations and unions. New methods of communication and partner cooperation must be developed and strengthened.

In the more-developed post-socialist countries, rapid liberalisation, continuous macroeconomic stabilization and extensive privatisation have established a new foundation for the gradual transformation of institutions that are needed for the successful functioning of market or knowledge-based economies; meanwhile, in less-developed post-socialist countries, the development of liberalisation is still slow and asymmetrical. The funds from the GDP are still mostly used for maintaining the unproductive residues of socialist enterprises and banks, and the environment does not support the development of new enterprises – the carriers of the knowledge-based economy. The basic problem of these enterprises has been the insufficient dissemination, transformation and application of knowledge.

References

[1] Adam, F., Makarovič, M., Rončević, B., and Tomšič, M. (2001). *Socio-Cultural Factors of Slovenian Developmental Success. Slovenia in the European Perspective* (in Slovenian). Ljubljana: Znanstveno in publicistično središče.
[2] Ministry of Development, General Secretariat for Research and Technology, Greece (2003). *The Barcelona 3% RTD intensity Objective.*
[3] Mrak, M., Rojec, M., and Silva-Jáuregui, C. (2004). Overview: Slovenia's Threefold Transition. In: Mrak, M., Rojec, M., and Silva-Jáuregui, C. (Eds.), Slovenia. *From Yugoslavia to the European Union*. Washington, DC: The World Bank.
[4] Pleskovič, B. (2003). The Knowledge Revolution, Transition Economies, and Civil Society. In: B. Jarc (ed.), *Proceedings of the Second World Conference of Slovenian Scientists and Researchers* (Maribor, Ptuj, September 20–22, 2001). Ljubljana: Slovenian World Congress.
[5] Stiglitz, J. (2002). *Globalisation and Its Discontents*. London: Penguin Books.
[6] World Bank. (2002). *Final Report of the Knowledge Economy Forum*, Paris, February 19–22,2002, Washington, D.C.

E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 2

The Knowledge-Based Society in South East Europe

Dr. Edvard KOBAL
Slovenian Science Foundation, Ljubljana, Slovenia

Abstract. Intense investment in the creation and expansion of new knowledge is characteristic for a knowledge-based society. Hence, it provides for the national economy with an appropriate amount of scientific research work and researcher potential, a suitable state budget structure, and fluidity of the results of scientific research work. In addition, it also enables close connections between the research and business sectors. In the forefront is the successful transfer of knowledge and technological advances into the economy. Investments into a knowledge-based economy and society can be measured by the following: the number of researchers, education expenditure, information infrastructure, level of lifelong learning, and the extent of investments into capital assets.

The article presents the most important parameters of the knowledge-based society, facts that contribute toward strengthening presentations about development in some countries, and the limitations that countries face in the process of implementing a knowledge-based society.

The decision for a knowledge-based society is the correct decision for all countries wishing to progress in their development on the basis of scientific revolution. This certainly holds for the transition economies of East-Central Europe too. Based on their decision for an information society and a knowledge-based society, politically and economically stable countries such as Slovenia, Hungary, the Czech Republic, Slovakia and Poland have chosen an appropriate speed of accession and integration into the European Union. Therefore, it seems normal that other countries whose main goal is to become part of the European Union in the near future (these are mainly South East European countries) set their strategic goals in the direction of establishing a knowledge-based society ever adapting to new challenges.

The decision for a knowledge-based society is in fact a U-turn, characterised by switching from a classic industrial society to a society where production, broader knowledge and its utilisation play a key role. The latter is associated with the organisation of education, advancement of innovation and formation of information-telecommunication infrastructure. Further, the fact that any operation in the economic sphere is largely affected by the social structure has to be taken into account. It means that socio-cultural factors also influence developmental success.

Slovenia, Hungary and Slovakia used the geographic nearness of members of the European Union, which facilitated the diffusion of innovation and other influences of scientific revolution and improved the starting point for the modernisation of society in the direction of a knowledge-based society. The accession of these countries to the European Union on 1 May 2004 will further advance the establishment of such a society, especially due to the common objectives (Lisbon, Barcelona) of the new, enlarged European Union. On the other hand, however, it will probably happen that the new neighbours of the European Union, the South East countries, will become more ready and adaptive for using the achievements of the scientific revolution for their own development and later on for their integration.

The decision for a knowledge-based society means that future development depends mainly on human capital, information and innovation. At the same time, it is a decision for development vs. underdevelopment or a central position vs. a position at the (sub) periphery.

Human capital is mainly important due to the capacity of the State to absorb and adapt knowledge to its development and to contribute to new knowledge. In this context, national, scientific, educational and technological policies advancing the capacity of the State for absorption and diffusion of knowledge are mandatory. Therefore, countries must invest in knowledge. Educational policy is definitely the key factor for catching up in technology.

Priority Investments into the Higher Education

The South East European countries have the capacity in the context of their national economies to focus appropriately on higher education – achieving the relevant number of students at the undergraduate and graduate levels. Curricula should be updated continuously to reflect the ever-changing nature of technology. Teaching methods should focus on learning, how to learn and student engagement, rather than on rote memorisation. At the graduate level, both students and faculty should be encouraged to conduct research.

The private sector should become much more active at planning and realising the educational policy of higher education. It should be the main promoter of various (also private) and not only State offers of educational programmes.

Priority Investments into Science-Research and Developmental Activities

Knowledge cannot be absorbed in a sufficient volume if there are not enough quality educated consumers, of whom dominate researchers, capable of reprocessing knowledge that originates out of the country into a form of knowledge being most beneficial for development within the national framework. Further, a sufficient volume of knowledge is necessary if we wish within the framework of the State and with own R&D human resources to develop new knowledge leading to new products, technologies and services. It is the latter that raise the interest of the economic sphere to support research and development. In this light, we may also look at the level and volume of co-operation between universities and research institutes. For the South East European countries, limited and non-systematic co-operation between the academic and economic spheres is characteristic. It probably originates in the socialistic era where co-operation between universities and research institutes on the one hand and universities and economic enterprises on the other could also be well developed (as for example in the more developed countries of ex-Yugoslavia), however it was based on direct ties between research institutions and enterprises. These kinds of connections were encouraged by the financial system, which apparently did not advance the diffusion of knowledge. It was especially not appropriate for smaller enterprises.

After the collapse of giant economic systems and expanded meaning of the SME-s, the model of direct relationships became even less appropriate.

The only exit out of this “inherited” situation is establishing conditions for genuine sharing of knowledge. However, it demands the development of a network of intermediate organisations enabling fast and efficient, yet not too complicated, transfer of knowledge and its market valuation. It is characteristic for the transition economies of East-Central Europe that they started to build up their systems of innovation diffusions only in the 1990s. The greatest progress in this context was made by Hungary. Slovenia, where specialised institutions are still not abundant and do not offer integral support, managed somehow less effectively. It wasn’t before the first years of the 21st Century, when Slovenia decided for a knowledge-based society, that substantial advancement occurred in terms of supporting economic enterprises in their endeavours to co-operate with the academic sphere, namely by promoting production clusters, incubators and technology centres and parks. It seems very likely that further support of the government and achievements recognised by economic enterprises will cause the movement of Slovenia and other new members (i.e. Central European countries) of the European Union to the European developmental core. This shall have a positive effect: a larger share of the economy for co-financing research on the State level.

Investments into Capacity Building

The capacity of absorbing knowledge is the first distinctive characteristic of members of a knowledge-based society. The second, even more important, characteristic is the capacity to adapt knowledge to local and national needs. This usually reveals the problem of a sufficient number of educated consumers of knowledge and known “short-term strategy” stemming from the early era of transition in the countries of South East Europe – the process of advancing study, especially post-graduate study, in most developed countries of the world, and mainly in the USA, Japan and the European Union. The benefits of such a strategy were, and still are, related to risks resulting in “brain drain”. Scholars choose to stay abroad or are forced to by artificial barriers or a lack of opportunities in their homeland.

In some countries of Central and South East Europe, this “short-term strategy” was already replaced by a “long-term strategy” building on new, high-quality international institutions in the region. Such institutions are, for example: Central European University in Budapest, the Center for Economic Research and Graduate Education in Prague, etc. [1]

Also, some interest on the part of some private American (U.S.) and European foundations arose to establish “Western-style” graduate schools in Central and South East Europe. These initiatives, and some already established institutions, were at first treated like “a foreign body” within the national environment. However, sooner or later they were accepted. Moreover, they brought freshness, attracted free-spirited professors and mainly gave a solid answer to the more and more demanding need for study. In fact, they became a factor in advancing the knowledge-based economy and the knowledge-based society.

Advancing the Absorption of Information-Communication Technology

The internet plays the key role in the revolution of knowledge. The number of people using personal computers and the internet in the countries of South East Europe is increasing all the time. Rapid development of the internet has resulted in the availability of a large volume of information and communication possibilities. The development of the internet, and especially the world-wide web, demands that educational processes on both sides (teachers and learning youth) adapt to new requirements. University teachers especially have to be aware of their new, modernised role. An important role of the knowledge-based society, also known as the information society, is the development of distance education. For the countries of South East Europe, nowadays, this kind of education already signifies the utilisation of modern forms of education based on extensive support of information technology and new media. It presents the future of education of this European sub-region. At the same time, it is important to be aware of the fact that this new form of learning also bears the necessity that the universities, along with other schools, as well as the governmental and economic sector, use a different strategy for planning and realising study matter and examination.

Creating a knowledge infrastructure demands the absorption of new technology for which the private sector should be attracted. The governmental sector in the countries of South East Europe should encourage economic enterprises operating in the field of information-communication technology to develop their own products and services and not only to sell foreign products. At the same time, the governmental sector should encourage all economic enterprises to do e-business.

Strengthening the Organisations of the Civil Society

In order to establish knowledge-based societies in South East Europe, a sound, civil third sector has to be formed. At this point, non-governmental and semi-governmental organisations advancing and promoting science play an important role. These organisations may be capable of addressing such challenges only if the economic and governmental sectors acknowledge their role and develop synergetic ties with them: the economic sector mainly by funding their programmes and projects, the governmental sector with tax relief for those economic enterprises investing into these organisations, and further by authorising (public authorisation) the management of part of the national, research, educational and technological programmes. Only the synergy of all three public sectors will result in the sufficient level of democracy needed for establishing and implementing a national science, education and technology policy leading to a real plan of the State in the near future to establish a knowledge-based society.

Currently, the countries of South East and Central Europe still have a small number of nationally important institutions of the third civil sector advancing and promoting science and collecting researchers, managers, teachers, journalists and other specific public representatives, with the aim of making conditions in the field of science and research, as well as the development and technology of the State, more democratic. The establishment of a sufficiently high level of democracy in relations between national science communities, and between these communities and the economic sector, is the first demand on the path toward a national, knowledge-based society. The second demand is encouraging different ways, ideas and thoughts concerning the establishment of a knowledge-based society, and attracting researchers of all generations, no matter where they currently reside, to unite their efforts toward establishing and operating such a society. Especially the governmental sector shall react to researchers' ideas and needs in terms of their active participation in the knowledge-based society. On the other hand, the governmental sector shall be prepared to confront their own activities and decisions by looking into the mirror given by non-governmental organisations, which, independent of the government, support the development of democracy in science and carry out their own independent investments into human resources, alternative research projects, new forms of international science co-operation and improved public understanding of science and modern technology.

The third demand is the necessity of partner co-operation between all three public sectors, actually establishing or maintaining a knowledge-based society in the State. It is because of this motive or goal being common to all three sectors that non-governmental organisations in the field of science and research, as well as development and technology, have the opportunity for a sustainable and recognised role in the society of the 21st Century.

Encouraging the Establishment of Informal and Formal Networks

In order to establish knowledge-based societies in the countries of South East Europe, it is important that researchers, developers and innovators establish informal as well as formal networks enabling the exchange of information and ideas. Additionally, it is important that they direct their inner power to common efforts aimed at the well being of the nation and humankind, especially in the field of higher education, developing new generations of researchers, as well as common interdisciplinary research and development projects. Doubtless, there is still a great deal of unused intellectual potential in the field of informal strivings directed toward concrete national and European strategic goals. The intellectual potential of the first decade of the 21st Century is free of the numerous barriers characteristic of the second half of the 20th Century. However, there are new dangers on the horizon, namely terrorism, which has transformed from a locally limited problem into a global one, as well as economic crime within the framework of some countries, which endangers not only relations between people but also the lives of people and their future.

References

[1] See article: B. Pleskovic (2000). The Knowledge Revolution, Transition Economies, and Civil Society. V *Book of Presentations on 2nd World Conference of Slovenian Scientists* (p. 14–25). Ljubljana: Slovenian World Congress.

Modernisation of Science Policy and Management Approaches in Central and South East Europe
E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 3

Elements of National Science and Technology Policy

Dr. Edvard KOBAL
Slovenian Science Foundation, Ljubljana, Slovenia

Abstract. Globalisation of the market economy has a great impact on connections between scientific research work and creation as well as the use of technologies. Therefore, it is not surprising that national science policies changed a great deal in the 1990s. The socio-economic research environment and, consequently, the concepts and practice of research policies have also changed under the influence of research politics.

In the centre of science policy-making is the realisation about the positive effect of scientific research work on economic growth and success and thus on social welfare. Increasing support for research is, therefore, not surprising. Many European countries realise that knowledge is the most important factor influencing economic growth and, accordingly, employment and welfare. On the other hand, a knowledge-based economy and society requires that innovations and innovation activities have a very important role. Therefore, the establishment and growth of innovation enterprises, a regulatory environment that fosters innovation, an improvement in "interim links" in the innovation system, and positive social inclinations for innovations must be encouraged.

Differences between research, technology, innovation and industry politics are decreasing. The integration of science and innovation policy is becoming prevalent.

Management of production, dissemination and application of knowledge must be based on national science, education and technology policies. The basic strategic aim of these policies is to increase the amount and transfer of knowledge and "availability" of knowledge for different forms of use. This demands the establishment of institutions and mechanisms for transfer and regulation. Their basic task is linking universities and research institutes as sources of knowledge with the economic sector, particularly with business enterprises. Technology centres and parks, innovation incubators, –spin-off business, offices for transfer of knowledge, think tanks and other institutions are part of the network of support that brings together the economic sector with academic institutions, as well as with the government and so-called third sector.

In addition to studies, expertise and other more or less publicly accessible initiatives of national academies of sciences, rector conferences, public funds and agencies that support science-research activity or technological development, several documents about science, education and technology policy exist. Incentives have also been raised in the framework of chambers of commerce and industry, chambers of craft, trade unions and NGOs, such as foundations that support science on a local, national and international level. Due to the diffusion of information sources, it is practically impossible for a publication like this to capture all contents, findings and recommendations. However, we must admit that different socio-cultural factors have a great impact on the developmental success of any individual country or group of countries in one of the European sub-regions, as well as on their economic competitiveness and their perspectives in the near future.

The relatively high mobility of researchers has influenced most countries of South East Europe to set up goals for the implementation of policies in the area of science, education and technology development, which echo progress in science. At the same time they have adjusted the "copy of global strategic and developmental needs" to their own nations. National science, education and technology policies are, consequently, more or less compromises. A stronger science community could express their "conditions" in politics, and change strategic goals on their behalf. In more bureaucratic countries, the science community plays, or has been playing, a more submissive role by giving consent to executive and legislative authority. However, on the other hand, this science community is more adaptable.

The European Science Foundation played a very important role in the 1980s and 90s, and the European Commission with its directorates, which were responsible for research, education and information society, in the 1990s. Science, education and technology policies in South East Europe have become more similar and unified. The implementation of these policies has stayed, of course, in the hands of the states. The attitudes of states toward implementation were different. Today, almost in the middle of the first decade of the 21st century, we can notice that their distance from the European development core is greater or smaller.

Most science and technology policies in the countries of South East Europe encourage – at least in writing, if not in fact – sustainable support to basic research at universities and research institutes, to development of human resources, to strengthening cooperation in the framework of the European Union's programmes for research or joint research programmes of the European Science Foundation. Technology policies emphasise the importance of linking sources of knowledge with corporations, especially industry, and building national innovation systems by encouraging the establishment and functioning of meditative and similar institutions; however, the practice shows limited success in the area of linking knowledge with potential users.

I. Elements of National Science Policies

By directing candidate countries toward EU membership, following the Lisbon and Barcelona conventions, all efforts in the EU were directed toward attaining the most competitive status of the economic community in the global area. In fostering a national knowledge-based society everyone saw an opportunity for accessing the European research core. This was certainly good; however, we can not delude ourselves. Verbal striving for a knowledge-based society is mostly in the interest of daily politics, but it does not contribute towards changes in society that would encourage the establishment of conditions for a knowledge-based society in the future. Politically initiated interest for a major change in the economic competitiveness of the old continent still raises some doubt if these strategic goals can be attained at all.

Basic Research

The key element of national science policies is certainly basic research. It is funded mostly by state budgets and, to a lesser degree, by business corporations and non-profit organisations. Most South-Eastern countries follow the strategic goals set up by the most developed countries of the world, particularly the USA. When it comes to importance, the effects of scientific and research work on economic competitiveness are in the forefront. In the last few years, after September 11 2001, the USA expanded its anti-terrorist programme. Considering the events in March 2004 (Spain), there is a great possibility that the European Union and other countries will follow the American example. The impact of global events, connectedness and dependency has also started to cause some changes in the science and technology policies of individual countries. The countries of South East Europe are no exception.

Larger or smaller tensions between universities and research institutions regarding the allocation of funds from national budgets for basic research are typical for most of South East Europe. Of course, the situation differs from country to country, since some countries have more developed research in research institutes that keep a certain level of co-operation with national academies of science, while in other countries with universities.

Weak association with the economic sector prevents the needed absorption of knowledge and the use of already developed knowledge.

Human Resources

Human resources are one of the basic elements of science policy. They are also one of the rare elements that enable most countries to develop strategies for attaining strategic policy goals. Of course, there is a need to reach a critical mass of researchers because this is the only way to reach proposed goals regarding the priority fields in science-research work and diffusion of knowledge. Attaining a critical mass of researchers is, of course, closely connected with the educational system, especially with university education on the undergraduate and graduate levels. Quality education and a satisfactory level of doctoral-level academic researchers are also very important. Hence, strategies must ensure strong long-term growth in the number of graduate students and a suitable increase in the number of graduate students registering for postgraduate studies and thus training for professional research work.

Scientific Publications

In most countries of South East Europe, the national mechanism encourages researchers to publish the results of scientific research in scientific publications, because citations of previous papers provide an indicator of the influence of a nation's scientific output. It is also necessary to know that – compared to the number of published articles in scientific publications – these researchers are infrequently cited by other researchers in the international community. This indicates that these (non-cited) researchers have (still) not reached the level of research considered valued and competitive by the international community.

Patent Citations

The strength or weakness of relations between research and innovation is clearly reflected by patent citations. Low numbers of science, as well as patent, citations are typical for most countries in South East Europe. The question is whether the publication of articles in scientific journals could be a basis for patent licensing or subsequent patents. Do university researchers contemplate such benefits of their research at all?

Promotion of Technology Transfer from Universities to Industry

An important element of science policy is also the promotion of university patenting of inventions from state-budget supported R&D. Most South East European countries do not have (sufficiently) developed legislative solutions regarding the licensing of university inventions to industry.

II. Elements of National Technology Policies[1]

Encouraging the economy to emphasise the importance of innovation with regard to attaining the competitiveness of economic corporations, especially industrial ones, on the international market is at the centre of national technology policies. Successful technology policy requires reciprocity between the governmental and economic sectors. The government must foster the development, commercialisation and use of technology. It also needs to invest both in a contemporary infrastructure that enables support for industrial production and in human resources that are fundamental for a knowledge-based economy (and society). Only highly educated, trained and competitive human resources can be a foundation for effective implementation of technology policy in the area of innovation management, as they are in science and research activity.

The duty of the governmental sector is to protect permanent and sufficiently strong investments in R&D and information-communication technology. This sector must encourage the development of a new technology policy that emphasises the global market and thus fosters a knowledge-based economy. Without developing new technology policies, which would promote and enhance a knowledge-based economy, it is impossible to expect that such an economy will materialise. Therefore, the governmental sector must promote and implement economic and regulative policies that enable effective co-operation between the economic sector and sources of knowledge. Sources of knowledge must understand the needs of the economic sector and vice versa.

Fostering R&D in Industry

Technology policy must foster R&D in industry. Researchers from institutions representing the sources of knowledge on the national level, ministries responsible for science, education, technology, development and economy, and also other state agencies for development, science and research activity, must have good insight into investments in R&D. At the same time, they must – in co-operation with the economic sector – create agreements that will enable the establishment of a knowledge-based economy.

Investments in Information-Communication Technology

Investments in information-communication technology are an important part of national technology policy. It is also important for economic enterprises, working in the area of

[1] The definition of the elements of national science (and technology) policies is based on the approach presented by Charles F. Larson, President Emeritus, Industrial Research Institute (USA).

ICT, to start developing their own products and services that permanently hold market interest. Such products and services can be also produced in South East European countries, but only by leading ICT enterprises capable of handling the production of at least one or more required components.

The national market is necessary for inventing and launching its own products, since only a product that is tested in practice can help to overcome the distrust of buyers outside the country of origin.

Today, at least some countries of South East Europe are capable of offering themselves as an area where new high-technology solutions for products and services can be tested and implemented on the pilot level.

With national technology policy, the governmental sector must encourage co-operation between companies in the area of ICT. This can be manifested in the form of technology centres and parks, networks or clusters.

Persuasive and realistic definition of the role of IT – as well as other contemporary and key technologies in national technology policy – can favourably influence the main ICT companies to set up, with the help of the governmental sector, strong and effective activity and thus contribute towards sustainable social development and improved welfare. For the economic fields of ICT are also important projects implemented by the governmental sector, such as e-administration.

The ICT companies, especially SMEs, have to pay special attention to trademarks and to development of infrastructure and co-operation. In addition to linking enterprises in the process of advancing to the international market, it is important – also in the case of ICT in most countries of South East Europe – to develop a critical mass of researchers to set up the basis for technological breakthrough, with the help of its own newly developed knowledge, and for market recognition. Hence, there is also the need for knowledge and experience from the areas of management and marketing.

Investments in Other Key Technologies

The advancement of enterprises of South East Europe to the international market depends not only on the level of their economic growth compared to countries of West and North Europe and their labour costs, but also on other modern technologies to which they should focus their attention and direct their national technology policies. In the area of environmental protection, especially the competitiveness of environmental protection technologies has to be improved. In the areas of biotechnology, nanotechnology and new materials, the possibility to develop products within a national framework has to be explored.

Formation of technology clusters and networks should become a priority.

Forming Alliances and Developing Partnerships

Forming alliances and developing partnerships is an important element of national science policy. One of the reasons for the latter definitely lies in sharing costs and risks. However, it is important to be aware of the fact that the majority of economic enterprises in the countries of South East Europe are still currently in a pioneer era of alliances and partnerships. Therefore, numerous problems associated with understanding goals, defining responsibilities and sharing intellectual rights arise.

Tax Incentives

Tax incentives present another element of national technology policy. If used appropriately by the governmental sector as a means of indirect subsidy, it may help economic enterprises more efficiently than a direct subsidy mechanism. In the majority of countries in South East Europe, direct subsidies are usually marked for selected enterprises experiencing crises. The governmental sector, of course, seeks that the major part of the subsidy returns to the State budget. Subsidies aimed at the technology breakthrough of enterprises are in fact investments enabling not only a breakthrough on the international market, but also the development of the enterprise and the employment of new researchers.

Venture Capital

Venture capital is usually an element of technology policies. It enables researchers, as well as others, to make a breakthrough with new products and services, and to establish new SME, start-up companies.

On the basis of available information it is possible to determine the presence of venture capital in South East Europe. The question is whether this (mostly foreign) capital is active or available for technology breakthrough. Another question appearing is how much venture capital was established in the form of funds by economic enterprises in individual countries in this European sub-region. The promotion of university-based venture companies is also important because they provide the conditions for the functioning of university incubators for start-up companies.

Patents

Inventions are the key for economic benefits from new or improved products, processes and services. The number of patents is not as important as their usability or utilisation, which shows the patents' factual technology value.

Modernisation of Science Policy and Management Approaches in Central and South East Europe
E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 4

Prioritisation in S&T and Selection of R&D Project Proposals – (Mis)Use of Western Models in South East Europe

Dr. Đuro KUTLAČA
"Mihajlo Pupin" Institute, Science and Technology Policy Research Centre, Belgrade, Serbia and Montenegro

Abstract. Setting priorities in Science and Technology (S&T) is one of the most crucial and at the same time most difficult tasks for governments, both in developed and developing countries. In transition economies, the lack of knowledge in foresight studies, Delphi, brainstorming and other methodological approaches in the process of strategy building is usually replaced by the collective work of special, so-called expert groups or committees, with the final outcome being a compromise between different interest groups rather than an expression of national priorities.

This chapter is organised in the following way: first, the broader concept of setting priorities is briefly explored, and different levels and dimensions of prioritisation and methods for the establishment of priorities are illustrated with several examples of national developmental priorities; second, one case study of research and development (R&D) project proposal selection procedure is presented, which is usually the next step in application of national S&T priorities; third, as concluding remarks, some lessons are extracted from a case study regarding the relationship between theory and practice in setting priorities and selection of R&D project proposals.

1. Introduction

Setting priorities in Science and Technology (S&T) is one of the most crucial and at the same time most difficult tasks for governments, both in developed and developing countries, and one more nightmare for transition economies, where the lack of knowledge in foresight studies, Delphi, brainstorming and other methodological approaches in the process of strategy building is usually replaced by the collective work of special, so-called expert groups or committees, with the final outcome being a compromise between different interest groups, rather than a profound set of national priorities. Ignorance along with the inability of governments and the S&T community to select priorities and allocate resources and efforts is one of the main reasons why research and development (R&D) systems in Central and Eastern European (CEE) countries have failed to support the transition of their economies [18].

This chapter is organised in the following way: first, the broader concept of priority setting is briefly explored and different levels and dimensions of prioritisation and methods for the establishment of priorities are illustrated with several examples of national developmental priorities (both in developed and developing countries); second, one case study of R&D project proposal selection procedure is selected, which is usually the next step in application of national S&T priorities; third, as concluding remarks, some lessons are extracted from a case study comparing theory and practice in priority setting and selection of R&D project proposals.

2. Priority Setting in Science and Technology

The need for setting priorities in S&T is a result of the serious concern of governments about the more efficient performance of the S&T system due to a significant and growing allocation of resources in S&T. Different concepts and approaches to the treatment and solving of the problem of priorities are caused by the differences between: a) types of research (fundamental and applied research and experimental development), b) actors involved in R&D (universities, government laboratories, industrial R&D units), c) responsibilities (local, regional, national authorities, international organisations), and d) interdependencies and relationships (R&D community, manufacturing sectors, services, economy and society as whole). Broad literature in S&T and innovation policy explores methodological aspects, concepts and methods as well as practical issues in the process of priority setting (with some of them referred to in this chapter). OECD documents tend to function as manuals and/or recommendations for general purpose and practical use; here will be extracted basic classifications of methodologies, methods and techniques for setting priorities in S&T from one such document [7] in four variations:

Firstly, the broader concept of setting priorities in S&T is based on the following two approaches [7]:

- The "thematic" approach – S&T fields, disciplines, projects, etc.
  Under this approach, priorities can be established within S&T fields, then within particular S&T disciplines and among different types of R&D projects, etc. The main actor involved in the process of setting priorities is the scientific community, largely because of the fact that the objectives, results and impacts of fundamental research are highly unforeseeable. Therefore, the process of negotiation is transferred to researchers, due to the lack of a "scientific" criterion for ranking importance between R&D fields. This is the so-called *bottom-up* or *science-push* approach.
- The "structural" approach – relationship between S&T and the economy and society and politics, elements of the innovation process;
  This is the so-called *demand/market-pull* or *top-down* approach. R&D activities are observed by society as a whole in order to have incentives, contributions and corrections directed to the improvement of economic performance, working and living conditions, and the wealth and culture of the nation. Therefore, even for fundamental research, priorities must be set with economic, social and political criteria combined with scientific criteria.

Secondly, one can distinguish three levels in managing the process of prioritisation:

- The strategic level;
  The main problems at the strategic level are a) how to establish priorities, b) how to implement priorities, and c) how to change priorities.
- The policy level;
  Prioritisation at the policy level includes political and administrative institutions, combining a) budget mechanisms and medium-term planning and b) interaction between S&T communities.
- The operational level;
  Prioritisation at the operational level includes actors at a) industrial enterprises, b) government laboratories, and c) universities.

Thirdly, differing levels of responsibilities and prioritisation in S&T can have three dimensions in one country:

- The national dimension;
  Governments are responsible for S&T development, allocation of national resources, and co-ordination of efforts on the national level. This implies the government's responsibility to introduce prioritisation in S&T as an instrument of integration of the S&T system into the national innovation system. Fundamental research activities, as the most costly, complicated and uncertain, should be primarily managed and realised on the national level.
- The regional dimension;
  Regional differences and specificities could be easier to manage through re-distribution of political responsibilities from the national to the regional level. Regional authorities should be more involved in the management of applied research and experimental development, which is an adequate reaction to the developmental needs of a particular region.
- The international dimension;
  Both national and regional authorities should be involved in appropriate international activities, which affect and involve S&T resources, according to already defined national/regional priorities and reflecting internationally determined priorities, either concerning S&T fields or specific activities and/or actions.

Fourthly, three groups of methods/methodologies can be set in order to differentiate appropriate approaches in the process of establishing priorities:

- The exploratory approach in the process of establishing priorities comprises a number of methods, such as a) peer review, b) studies of critical/key technologies, c) brainstorming, d) panels, e) scenario building, f) Delphi, g) game theory, h) simulation, i) analogies, j) morphological analysis, k) dependency matrix, l) catastrophe theory, m) intuitive method, etc.;
- The normative approach uses a) pattern analysis, b) system analysis, and c) forecast as the main methods for establishing priorities;
- Foresight in S&T is a methodological approach [16] that combines the above-mentioned methods and techniques in order to establish, as its main outcome, a *coordinated (C1)* process of negotiation and *communication (C2)* between all interested partners (S&T community, industry, financial institutions, governments, non-governmental institutions, etc.), while building awareness and capacity for *concentration (C3)* on long term planning and, finally, setting priorities with broad *consensus (C4)* and *commitment (C5)*. This *five C's* approach has become the main methodological instrument for a number of OECD and EU member countries in the last several decades, but only one CEE transition country (Hungary) has completed one three-year-long foresight exercise so far.

Theoretical dimensions, methodologies, methods and techniques for priority setting in S&T discussed in this chapter will be illustrated with two examples, one highlighting the national and one highlighting the international dimension of this process. Table 1 shows S&T priority fields in Sweden, Germany, the United Kingdom, Austria and Hungary established in 1998–1999 as a result of two to three years of previous priority setting activities. The priorities are grouped (by the author) in order to illustrate national similarities as well as specificities, economic capabilities and development aspirations in. The table heading also shows different methodological approaches, such as Delphi and foresight, used in the process of S&T priority establishment. The UK foresight panels expressed a national attitude, preferring panel *discussions* to Delphi-based *writings* about future developments.

Table 1. Priority S&T Fields in Selected Countries, Established in 1998–1999.

Sweden	**Germany**	**United Kingdom**	**Austria**	**Austria**	**Hungary**
Technology Foresight	*Delphi*	*Foresight Sector Panels*	*Society / Culture Delphi*	*Technology Delphi*	*Foresight Panels*
Information and Communications Systems	Information and Communication	IT, Electronics and Telecommunications			IT, Telecommunications, Media
Health, Medicine and Care	Health and Life Processes	Health and Life Sciences	Health and Illness in Social Transformation Ageing and Life Cycle	Medical echnologies and Support Technologies for the Elderly	Health (Life Sciences, Health Care, Medical Instruments, Pharmaceuticals)
	Agriculture and Nutrition	Agriculture, Horticulture and Forestry Food and Drink		Production and Processing of Organic Foods	Agribusiness and Food
Education and Learning		Leisure and Learning	Lifelong Learning	Lifelong Learning	Human Resources (Education, Employment)
Biological Natural Resources	Environment and Nature	Natural Resources and Environment			Natural and Built Environment
Community Infrastructure	Construction and Dwelling	Construction	New Forms of Housing and Living	Environmentally Sound Construction and New Forms of Housing	
	Energy and Resources	Energy			
Materials	Chemistry and Materials	Materials Chemicals		Tailor-Made New Materials	
Production Systems	Management and Production	Manufacturing, Production and Business Processes	Cleaner Production and Sustainable Development	Cleaner Production and Sustainable Development	Manufacturing and Business Processes (New Materials, Supplier Networks, Globalisation…)
	Mobility and Transport	Transport Retail and Distribution		Mobility and Transport	Transport
Service Industries	Service and Consumption	Financial Services	Structural Change of Work		
	Space	Defence and Aerospace	Social Segmentation		
	Large Science Experiments	Marine			

Sources: [1], [2], [5], [6], [12]. Distribution of groups arranged by the author.

The Austrian Delphi exercise is an important example for countries of similar size, economic structure and level of development, etc. The absence of information and communication technologies from the technology Delphi list is a result of the country's awareness that its national capabilities and resources should be engaged in the improvement of its techno-economic capabilities and competitiveness in the sectors of production and/or services in which Austria can achieve international competence, like metallurgy (steel production), rather than compete in technologies in which a small number of global "players" are able to contribute to their development. Several years later, the results of benchmarking enterprise policy in EU member countries found that ICTs are an area of strength in the Austrian economy [3]! Specificity in Austria is a parallel process of society/culture and technology Delphi, clearly emphasising the importance of both aspects of development: techno-economic and socio-cultural.

Table 2. Change in Priorities between EU Framework Programmes.

Framework Programme	**'82**	**FP1 84-87**	**FP2 87-91**	**FP3 90-94**	**FP4 94-98**	**FP5 98-02**	**FP6 03-07**
Total - MECU	500	3750	5396	6600	13100	13700	16270
Total - (%)	100	100	100	100	100	100	100
Homogeneous Groups:	**Share in Total (%)**						
Information and Communication Technologies	10	25	42	38	28		
User-friendly Information Society						26	
Information Society Technologies							22
Life Sciences and Technologies	3	5	7	10	13		
Quality-of-Life and Management of Living Resources						18	
Life Sciences, Genomics and Biotechnology for Health							14
Transport	0	0	0	0	2		
Industrial and Materials Technologies	9	11	16	15	16		
Energy	66	50	22	16	18	8	
Nanotechnologies and Nanosciences							8
Aeronautics and Space							7
Food Quality and Safety							4
Environment	9	7	6	9	9		
Environment and Sustainable Development						8	
Competitive and Sustainable Growth						20	
Sustainable Development, Global Change and Ecosystems							13
Promotion of SMEs						3	
Horizontal Research Activities Involving SMEs							3
Human Capital and Mobility	3	2	4	9	6		
Human Research Potential						9	
Socio-Economic Research	0	0	0	0	1		
International Co-operation	0	0	2	2	4		
International Role of Community Research						3	
Specific Measures in Support of International Co-operation							2
Dissemination & Exploitation of Research	0	0	1	1	3		
Joint Research Centre						5	
Non-Nuclear Activities of Joint Research Centres							5
Structuring the European Research Area							16
Strengthening the Foundations of the European Research Area							2
Policy Support and Anticipating S&T needs							3
Citizens and Governance in a Knowledge-Based Society							1

Sources: [8], [24], [25]. Distribution of groups arranged by the author.

The International dimension in S&T priority setting is illustrated by the data in Table 2, which expresses the primary priority fields and activities in all European Union (EU) Framework Programmes devoted to the support of R&D activities in member and accession countries. The priorities are again grouped (by the author) in order to illustrate the changes in EU general objectives, types of programmes, actions and activities. Sharp changes started with the Fifth Framework Programme (FP), which introduced much more human-oriented development and, encompassed with the Sixth FP, directed the establishment and structuring of the European Research Area (ERA) as the common R&D base of unified Europe, treating ERA as the only R&D system able to compete with the US and Japan.

Table 3. Number of Priority Themes in Basic Sciences in Serbia for the Period 2002–2004.

Field of Science	Number of Priority Thematic Fields	Priorities in Physics – Detailed Structure	Number of Priority Thematic Fields
Physics	22	Physics of Atoms and Molecules	4
Biology	6	Plasma Physics	4
Astronomy and Geo-Sciences	15	Materials (incl. Nanotechnologies)	6
Humanities	43	Quantum Physics	2
Chemistry	6	Particle Physics	2
Mathematics and Mechanics	21	Nuclear Physics	4
Medicine	6	**Total Number of Priorities**	**22**
Social Sciences	7		
Total Number of Priorities	**126**		

Source: [19]

3. Selection of R&D Project Proposals – A Case Study

The research and development (R&D) project selection procedure is usually the next step in the application of national S&T programmes and use of S&T priorities discussed in the previous section. Operations research as a specialised scientific field offers a number of methods and techniques for R&D project selection. Although these methods and techniques are known world-wide, transition economies are again faced with a number of problems, such as:

- Lack of a sufficient number of scientists who can be employed in the process of peer review;
- Strong organisational pressure on evaluators, implying that their independence is “mission impossible”;
- Insufficient knowledge about S&T trends in leading OECD economies as a result of weak communications and detached S&T systems;
- Strong disputes between parts of a disintegrated S&T system that is in the process of restructuring and transformation, etc.

S&T priority setting procedure and national R&D project selection procedure in the Republic of Serbia, organised in 2001 for financing basic research projects during the period 2002–2004, will be briefly presented as a case of one transition in the CEE economy, where most of the above-mentioned problems in R&D project selection and disputable S&T priority setting procedure appeared.

3.1. Setting Priorities for Science

The first activity in the process of launching a new three-year long period of financing basic research projects in Serbia for the period 2002–2004 was setting national priorities in basic sciences. The procedure used for setting priorities in basic sciences is the formation of expert panel groups for eight fields of science. As a result of the “science-push” approach, 126 priority thematic fields are defined altogether – see Table 3 with examples of the structure of priorities in physics. Practically, just few sub-fields of basic sciences could be declared as being of less importance, and some panels list them along with selected ones [19].

3.2. Project Application and Selection Procedure

The list of priority thematic fields is adopted by the Ministry of Science, Technology and Development as a “Research Program” [19], along with the procedure for submission of project applications [13] and the procedure for evaluation of project applications [10]. Methodologi-

Table 4. Procedure for Evaluation of Project Applications.

Evaluation Phase	Activity / Description
I: Pre-Selection / Formal Check of Project Application Form	Compliance with Respect to Requested Data
	Completeness of the Application Form
	Check of Accuracy in the Application Form
II: Evaluation of Research Plan by Criteria K1-K5	K1 - Scientific Justification of Proposed Research
	K2 - Scientific Foundation of Project Application
	K3 - Contribution to Attainment of Priority Thematic Fields
	K4 - Applicability of Project Results
	K5 - Originality of Research
III: Evaluation of Project Contributors	K6 - Project Cost
	K7 - Competence of Project Team
	K8 - Competence of Project Leader
	K9 - Equipment for Project Realisation
IV: Ranking Lists of Project Applications	Comparison Between A and A3 (if difference > 30%, then new evaluation of project proposal)
	K10 - Risk for Project Realisation
	K11 - Risk for Implementation of Project Results
	Ranking List According to Single Criterion: RL1-RL11
	Ranking Lists for A1, A2, A3: RL12, RL13, RL14
	Ranking List According to Aggregate Mark A-RL15

Source: [10]

cally, the project application and selection procedure is based on: a) the project application and selection procedure proposed by the EU Commission for Implementation of the Fifth Framework Programme, b) international peer review procedure, and c) generally used operations research methods and techniques.

The form for submission of project applications is an adapted form for submission of research proposals under the EU Fifth Framework Programme [11]. According to the applied EU approach in submission of project proposals, general criteria for the evaluation of a project application are also adapted from the same source. Therefore, the list of criteria given in Table 4 is based on the same evaluation purpose, and all modifications and added criteria are due to use of the particular MCDM (Multiple Criteria Decision Making) method [23].

The Procedure for Evaluation of Project Applications consists of four phases:

1. Evaluation Phase I: Pre-selection / Formal Check of Project Application Form;
   In this phase, MSTD administration checks all applications for completeness and compliance with the requested data as well as the accuracy of completed forms. During this phase, some minor changes and modifications are permitted in order to improve the applications and prepare them for peer review procedure.
2. Evaluation Phase II: Evaluation of Research Plan;
   Phase two is the first peer evaluation activity, allowing a review of only the first part of the application form consisting of data relevant to the first five criteria (K1 to K5). The evaluators are able (permitted) to proceed only after competition of Phase II. The aggregate evaluation for the first five criteria is the arithmetical mean of single criterion evaluations.
3. Evaluation Phase III: Evaluation of Project Contributors;
   This phase is the evaluation of resources and researchers as well as project leadership. Peer review is based on data relevant to criteria K6 to K9. The aggregate evaluation for the second group of criteria is the arithmetical mean of single criterion evaluations. This is the end of peer contribution to the evaluation procedure.
4. Evaluation Phase IV: Ranking Lists of Project Applications.
   Two peers should evaluate all project applications. Phase IV consists of two steps: the first step is a procedure used to check peer objectivity, based on comparing pairs of

Table 5. Selection of R&D Project Proposals in Serbia, Basic Sciences, Year 2002.

Field of Science	Application	Evaluation	Rate of Success	Evaluation (Modified)	Rate of Success After Modification
Physics	51	25	49.0%	49	96.1 %
Chemistry	79	35	44.3%	74	93.7 %
Biology	70	36	51.4%	68	97.1 %
Astronomy and Geo-Sciences	32	14	43.8%	27	84.4 %
Mathematics	58	21	36.2%	53	91.4 %
Medicine	238	56	23.5%	152	63.9 %
Language and Literature	24	9	37.5%	19	79.2 %
History	56	29	51.8%	50	89.3 %
Social Sciences	64	22	34.4%	57	89.1 %
TOTAL	**672**	**247**	**36.8%**	**549**	**81.7 %**

Source: [26] and the author's working documents

evaluations for each application. In the event that these evaluations differ by more than 30%, a third evaluation is requested by this procedure. This comparison is combined with a comparison of single criterion evaluations, the first two aggregate marks and evaluation of applications under criteria K10 and K11. If peer objectivity is not questioned, ranking lists according to single and aggregate criteria are formed and presented to decision-makers for a final decision.

Evaluation of project applications is based on international peer review procedure. Negotiations between the Serbian ministry (MSTD) and ministries in Italy and Germany succeeded with an agreement between Serbia and Italy – the University of Bologna agreed to evaluate research proposals from Serbia (important note: the Italian government and the University of Bologna agreed to cover the expenses for this evaluation – estimated at almost €500,000 – as a donation to the R&D system in Serbia). The data in Table 5 presents the results of the evaluation procedure.

The difference between the rates of success for applications based on original evaluations in Italy and the rates of success based on modified evaluations done in Serbia resulted from a political decision in the Serbian ministry that the majority of researchers should be supported during the period 2002–2004. This departure from the original selection policy is based on the fact that Serbian science was almost one decade behind the world science community. Therefore, the modest references (causing a low level of evaluations) could be explained as a result of this lag, and suggests that one more chance for re-integration into this community must be given to the basic sciences in Serbia.

4. Concluding Remarks

The lessons one could learn from the case study of R&D project selection procedure in Serbia explored in the previous section can be grouped in four dimensions:

- International vs. domestic dimension;
  Lack of national capacities and competencies for priority setting as well as other activities in management of one R&D system could be overcome with the help of the international R&D community. A prerequisite for this is readiness to acknowledge the necessity to ask for help and to accept foreign experts' opinions and findings, whatever they might be. The reaction of the R&D community in Serbia regarding expert evalua-

tions from Italy was rather critical. Although it was obvious that domestic R&D capacities are not sufficient and objective enough, the involvement of peer review from Italy was not welcomed.

- Selectivity vs. solidarity;
  Another fact that supports our findings that it is difficult for the domestic R&D community to be objective enough is the number of defined priority thematic fields. Such a large number of priority thematic fields (126) is the result of compromises between panel members rather than strong selection, which can focus national efforts but can also jeopardise the positions of a number of researchers in the country.
- Scientific vs. political criteria;
  The practical implementation of original evaluations could result in a difficult situation for a major part of the R&D system. Therefore, the Ministry made a political decision in order to relax the number of critical levels for the criteria used in the evaluation procedure. This confirms findings that the use of scientific procedure and criteria in the process of management of the R&D system cannot be separate from broad political aspects, i.e. management of the R&D system is a very political as well as scientific process.
- Scientific autonomy vs. socio-economic responsibility.
  The authorities and the general public, particularly in financially limited circumstances, always question the "bottom-up" or "science-push" approach, which is only acceptable for the R&D community. The usual argument that R&D results are unpredictable and usually less economically effective in the short term, but could be very important for the economy as well in the long term, can hardly be defended even in developed OECD economies. The R&D community is forced to redefine its activities in order to increase the visibility and economic performance of scientific research. Therefore, use of the criterion "*Applicability of Project Results*", highly questioned by researchers, has become the standard criterion by which the socio-economic responsibility of the scientific community is considered.

The final outcome of this case study can hardly be called selection, because of the fact that limited financial resources are equally distributed among researchers (so-called "zero-sum distribution") and because of postponement of the process of restructuring the R&D system. Keeping in mind that these R&D projects last three years, delays in transition from the Soviet R&D system model to a National Innovation System in which the R&D system is an integral part are very serious and, for all practical purposes, caused by public authorities. The public authorities were either unable to cope with transitional processes or hesitant to make any decision that could change the structure of the R&D system before substantial improvement of the national economic situation. Adopted projects could prevent the further disintegration and disappearance of national R&D resources and this can be the main result of project selection procedure. Compromise between scientific and political motives is the final outcome of implementation of theory in practice, referred to in transition research as "gradual, passive restructuring" or "gradualism without therapy", where "*institutional financing is still dominant and there is no systematic policy or attempt to restructure the R&D system – the salvation of national science is taken as a cover for saving jobs in the R&D sector*" [18].

References

[1] Aichholzer, G., The Austrian Foresight Programme – Overall Organisation and Technology Delphi. Workshop: Foresight Methods: International and Hungarian Experiences. Budapest, 1–2 July 1999.
[2] Balint, V., Technology Foresight: The British Case. Workshop: Foresight Methods: International and Hungarian Experiences. Budapest, 1–2 July 1999.

[3] Benchmarking Enterprise Policy – Results from the 2002 Scoreboard, Commission Staff Working Paper, SEC (2002) 1213, European Communities. Luxembourg, 2003.
[4] Coates, J.F., Foresight in Federal Government Policy Making, Futures Research Quarterly, 1985, 1:29–53. In: B. Menlen, The Impact of Foresight on Environmental S&T Policy in the Netherlands, Futures, Vol.31, Number 1, pp. 7–23, February 1999.
[5] Cuhls, K., Foresight with Hindsight: Japanese and German Experience. Workshop: Foresight Methods: International and Hungarian Experiences. Budapest, 1–2 July 1999.
[6] Deiaco, E., Technology Foresight in Sweden. Workshop: Foresight Methods: International and Hungarian Experiences. Budapest, 1–2 July 1999.
[7] Drilhon, G., Choosing Priorities in Science and Technology, OECD, Paris, 1991.
[8] European Report on S&T Indicators, Second Edition, CEC, Directorate-General XII Science, Research and Development, U. Muldur (ed.). Brussels, 1999.
[9] Foresight – The Regulatory Implications of the Convergence in Telecommunications, Broadcasting and Information Technology. Office of Science and Technology, Department of Trade and Industry, London, August 1998.
[10] General Criteria and Procedure for Evaluation of Project Application Forms for Participation of MSTD in Financing of Projects in the Fields of Basic Research. Ministry of Science, Technology and Development (MSTD), Republic of Serbia, Belgrade, June 2001.
[11] "Guide for Proposers", The Fifth Framework Programme focuses on community activities in the fields of research, technological development and demonstration (RTD) for the period 1998 to 2002, Third Edition 15.03.2001.
[12] Havas, A., Foresight in a Small Transition Country. Workshop: Foresight Methods: International and Hungarian Experiences. Budapest, 1–2 July 1999.
[13] Instructions for Preparation of Application Form and Application Form for Participation of MSTD in Financing of Projects in the Fields of Basic Sciences. Ministry of Science, Technology and Development (MSTD), Republic of Serbia, Belgrade, June 2001.
[14] Kutlača, Đ., Foresight Serbia, working document (in Serbian). "Mihajlo Pupin" Institute, Science and Technology Policy Research Centre, Belgrade, 2002.
[15] Martin, B.R., Technology Foresight – A Tool for Strategic Research Policy. OST/SPRU/Nature Conference on Research Policies for Europe's Future: Strategies and Perspectives. Paris, 28–29 September 1995.
[16] Martin, B.R. and Irvine, J., Research Foresight: Priority-Setting in Science. Pinter Publishers, London and New York, 1989.
[17] Proposal for a Decision of the European Parliament and of the Council Concerning the Multiannual Framework Programme 2002–2006 of the European Community for Research, Technological Development and Demonstration Activities Aimed at Contributing Towards the Creation of the European Research Area, COM (2001) 94 Final, 2001/0053 (COD), 2001/0054 (CNS), Commission of the European Communities. Brussels, 2001.
[18] Radošević, S., Restructuring and Reintegration of Science and Technology Systems in Economies in Transition. Summary of the project funded by DGXII of the European Commission under the Targeted Socio-Economic Research (TSER) Programme, 1996–98, Project Coordinator Slavo Radošević, SPRU-Science and Technology Policy Research, University of Sussex, UK, April 1999.
[19] Research Program – Priority Thematic Fields in Basic Sciences (in Serbian). Ministry of Science, Technology and Development, Republic of Serbia, Belgrade, June 2001.
[20] Science, Technology and Industry Review: Special Issue on Public Support to Industry. STI Review, No.21, OECD, Paris, 1998.
[21] Science, Technology and Industry Outlook 2000, OECD, Paris, 2000.
[22] Technology Foresight & Sustainable Development, DSTI/STP/TIP(99)8/FINAL, OECD, Paris, 1999.
[23] Zeleny, M. (ed.), Multiple Criteria Decision Making. Kyoto, 1975. Lecture Notes in Economics and Mathematical Systems: Operations Research, No. 123. Springer-Verlag, Berlin, 1976.
[24] www.cordis.lu/fp5/budget.htm#.
[25] www.cordis.lu/fp6/budget.htm#.
[26] www.nauka.ac.yu.

E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 5

Transformation of Research and Innovation Policy in New EU Member and Candidate Countries: What Can We Learn From It?

Dr. Slavo RADOSEVIC
School of Slavonic and East European Studies, University College London, United Kingdom

Abstract. This chapter summarises the key issues of innovation policy in the new EU member and candidate countries (NMCCs). Their recovery and growth has not led to the automatic recovery of demand for R&D and technology. Innovation processes still seem very much focused on the mastery and use of machinery and equipment, with a limited R&D component. Technology effort in the NMCCs is still very much concentrated on the mastery of production capability, with important policy implications.

Innovation policy has only recently re-emerged in the CEECs after having been relegated to a secondary role during the transition process. The early to middle 1990s saw the focus of innovation policy in the NMCCs to be much on so-called bridging institutions (academy-industry relations, S&T parks, commercialisation issues). Overall, the effects of these policy efforts have been disappointing due to several analysed factors.

In order to be effective, innovation policies in the CEECs should recognise the structural weaknesses of their individual innovation systems. This will require a search for country-specific solutions, as opposed to the rather imitative mode that has so far prevailed.

1. Background

During the 1990s, growth in the countries of Central and Eastern Europe (CEE) was mainly based on removing distortions and introducing macro- and micro-organisational innovations [1,8,9]. Extensive econometric work undertaken by World Bank and IMF staff shows that the major factors explaining recovery and growth in the CEECs were initial conditions, macroeconomic policies, and structural reforms[1].

During this period, reallocations and restructuring were much more important for growth than factor accumulation. Factor expansion has not been significantly linked to growth in the transition period. For example, aggregate investment ratios have no explanatory power. Efficiency gains appear to be the main, if not sole, source of growth [11].

[1] For example, see Havrylyshyn, Oleh (2001); Fischer, Sahay and Vegh (1998); and Berg, Borensztein, Sahay and Zettelmeyer (1999).

From an innovation policy perspective, it is important to recognise that growth during the 1990s was not directly linked to domestic research & development (R&D). The correlation between the growth rates of GDP and GERD/GDP during the period 1990–2002 shows that the relationship is very much country-specific. It ranges from highly negative correlation coefficients between changes in GDP and GERD/GDP for Romania and Latvia to highly positive changes for the Czech Republic and Estonia[2]. As we analysed elsewhere [10], the downsizing of the R&D systems in CEE was not systematically linked to a specific individual factor on the demand or supply side. It is probably the combination of demand-side factors (annual changes in GDP and investments) and supply-side policies (budgetary R&D policy) that in the end shaped trends in R&D spending. Neither government nor market demand for R&D could buffer this fall.

R&D systems have played a relatively small direct role in the current performance of CEE economies. However, we should not ignore the importance of R&D systems based merely on their current role. The role of R&D is likely to increase with a return to growth. In fact, the restructuring of R&D is one the key preconditions for further industrial upgrading. In addition, its role cannot be evaluated only through its direct contribution to innovation but needs to be viewed also through its contribution to education and the transfer of research methodologies and techniques and as an important factor of absorptive capacity [2,3].

This issue has become an important policy topic. For example, European Commission [6] recommendations on economic policies that for the first time included new member states point to key problems seen as important with regard to improving the productivity of new EU members. These are: low investments in R&D and innovation and in retraining activities; low efficiency of education systems and vocational training; and in the cases of Slovenia and the Czech Republic, low efficiency of R&D and innovation. Recommendations to increase investments in business R&D and innovation and in vocational training stand as a prominent mechanism through which all of the new member states could increase productivity.

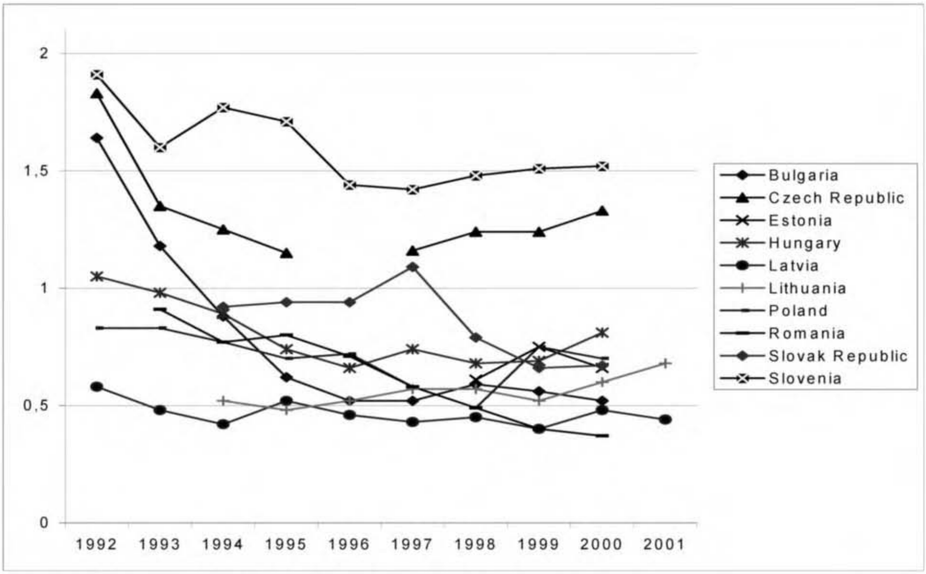
This brings us back to innovation policy, which for the entire period of the 1990s was relegated to a residual activity squeezed by the primacy of stabilisation, and transition-related policies like privatisation, liberalisation and institutional reform. In addition, EU accession has given a new boost to innovation policy as an important mechanism for the use of EU Structural Funds. Hence, the aim of this chapter is threefold: first, we review the problem of growth and restructuring in the new EU member and candidate states from an innovation policy perspective (Section 2); second, we assess the innovation policy of the new member and candidate states (Section 3); and third, in the conclusion we outline two key challenges of innovation policy and summarise the key points.

2. Growth, R&D and Innovation in Central and Eastern Europe

During the 1990s, the new EU member and candidate countries experienced deep structural changes. These ranged from transformations in sectoral and industrial structures to changes in economic systems. The issue is whether these changes were sufficient to ensure catch-up in a period in which growth increasingly depends on the generation, use and diffusion of knowledge. A proper answer to this question goes beyond the scope of this chapter. Nevertheless, we tentatively attempt to address this issue by pointing to some relevant evidence.

First, a radical shrinking of R&D systems in all of the CEECs was followed by the stabilisation of relative gross expenditures on R&D (GERD) at very low levels (see Fig. 1). A

[2] Radosevic, S. (2004) Are Systems of Innovation in the CEECs (In)efficient?, mimeo.



Source: OECD, Eurostat, CIS and national statistics

Figure 1. Shares of Gross Expenditures for R&D in GDP, 1992–2001.

recovery in the second half of the 1990s was not followed by a recovery in R&D. This shows that there was a limited demand for local R&D. A recovery in growth was not automatically followed by a recovery in R&D, which may be of concern regarding sources of long-term growth.

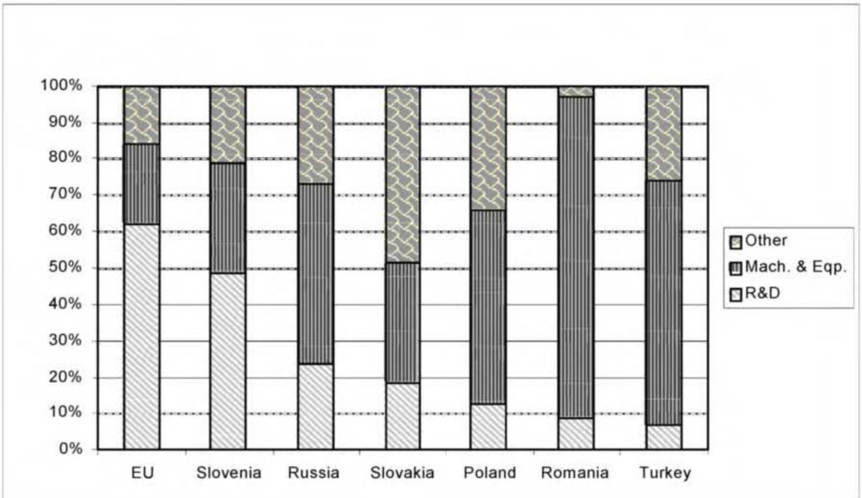
Part of the reason for the absence of demand for R&D can be found in the nature of innovation in CEE. Figure 2 shows that innovation is primarily based around new equipment, most often imported, in the CEECs.

The share of R&D in total innovation costs in the NMCCs, Turkey and Russia is significantly lower than in the EU. Only in the case of Slovenia, which is the CEEC with the highest GDP per capita, is the share of R&D expenditures close to the EU average. A very low share of R&D expenditures in innovation costs explains why the demand for GERD is weak despite recovery in growth in the late 1990s. Innovation in CEE is focused around new equipment and its efficient use. The limited R&D that is employed in innovation processes is primarily for facilitating the adoption of newly acquired equipment.

The EU Innovation Scoreboard (EIS) is a composite indicator that uses 17 indicators to represent innovation activities [7,12]. Figure 3 uses the simple trend average of all available indicators and compares the "old" EU with the EU accession and candidate countries. It shows that in terms of trends, 8 out of the 12 countries (CEECs and Turkey) are falling behind in EIS indicators.

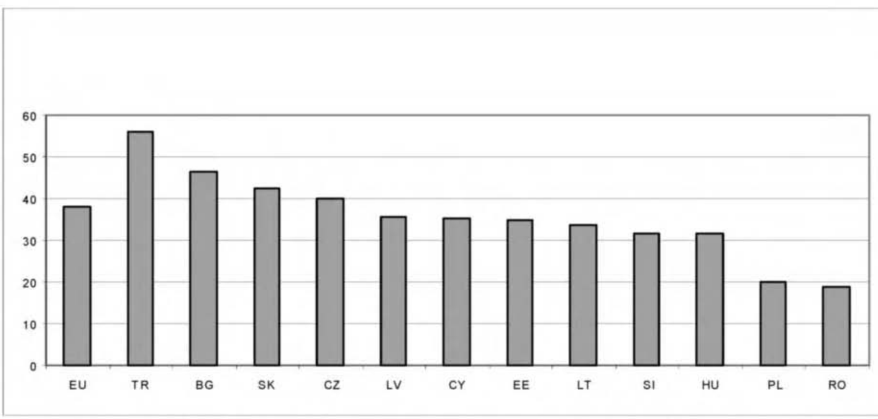
A detailed examination of individual EIS (EU Innovation Scoreboard) indicators, which are not reported here due to space limits, shows that there is not a general catching up in the innovation indicators of the CEECs. In addition, not one individual country has managed to catch up in a single EIS category.

The above data seems to suggest that the CEECs have not been catching up in terms of innovation. However, it would be wrong to conclude that technology effort has not been taking place in these economies. In economies that are catching up, firms are often mainly focused on improving the efficiency of their existing products/processes, i.e. production



*Different years in the second half of the 1990s
Source: Eurostat and national sources

Figure 2. Structure of Innovation Expenditures in Manufacturing, in %*.



*Note: Trends are calculated as the percentage change between the last year for which data are available and the average over the preceding three years, after a one-year lag.
Source: Calculated based on [12]

Figure 3. Innovation Scoreboard Trends 2002*.

capability. There are not direct statistics for production capability, and those that are available are industry-specific, which greatly reduces inter-country comparability. We instead use ISO9000 generic quality certificates as an indicator of production capability[3].

Figure 4 shows that mastery of production capability in CEE is still low. However, there are already differences between the CEECs, with Hungary and Slovenia being significantly ahead of the rest. Overall, the relative number of per capita certificates in the CEECs is from 0.5 to 10 times lower than in the majority of the "old" EU members. However, this

[3] ISO – International Standards Organisation.

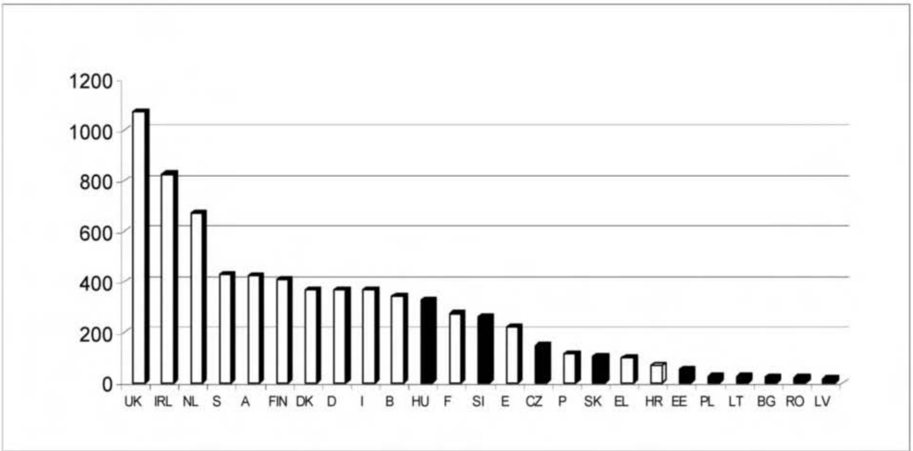


Figure 4. Number of ISO9000 Certificates Per Capita, 2001.

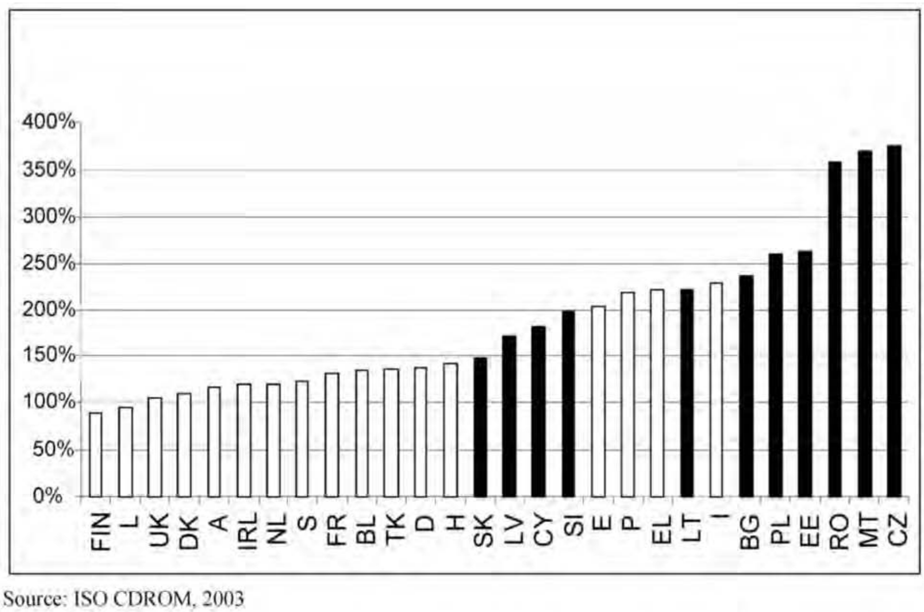


Figure 5. Change in Number of ISO9000 Certificates, 2001/1999 (%).

figure reveals levels, while catching up primarily denotes dynamics. Figure 5 shows that some CEECs are catching up in terms of ISO9000 certificates per capita. The rate of change between 1999 and 2001 was 0.5 to 2.5 times higher in the new member and candidate countries than in the majority of the "old" EU member states. Moreover, there is some tendency towards convergence, as those CEECs and new member states that are far behind (Romania, Bulgaria, Poland, Lithuania) in terms of levels have, on average, the largest increases. This may mainly reflect their low absolute level, and it remains to be seen whether we will see them catching up in terms of production capability.

A comparison between countries that are catching up and countries on the frontier of technology suggests that this comparison cannot be confined to innovation capabilities. Industrial upgrading requires technology developing, as well as technology using, capabilities. The causes of the productivity gap in the CEECs may have more to do with problems of technology use, i.e. production capability, than with innovation capability. This is very important for the innovation policy of the CEECs, which have had to embrace not only innovation but also a productivity improvement agenda.

In summary, the recovery and growth of the CEECs has not led to the automatic recovery of demand for R&D and technology. Innovation processes in the CEECs still seem very much focused on the mastery and use of machinery and equipment, with a limited R&D component. The technology effort in the CEECs still seems very much concentrated on the mastery of production capability, with important policy implications. Hence, in the remaining part of this chapter we address the innovation policy issues involved in CEE catching up.

3. Emerging Innovation Policy in Central and Eastern Europe: Factors and Structural Weaknesses

As pointed out in the introduction, innovation policy in the CEECs was not at the forefront of policy attention during the 1990s. However, with recovery and growth, we see the re-emergence of innovation policy in most of the CEECs[4] [4,5]. How do we explain that innovation policy in the CEECs has re-emerged only with recovery and growth? Can we explain this shift only by the pro-cyclical nature of the CEECs' innovation policy? This would probably be an oversimplified view. Several CEECs, like Hungary and Slovenia, developed innovation policy from the early 1990s. Poland, whose economy started to grow and was the first whose GDP surpassed its 1989 level, did not enhance its innovation policy earlier than other countries.

Although the revival of growth has played an important role in the re-emergence of innovation policy, it cannot explain it fully; a variety of nationally specific and common external factors have played an important role as well. For example, the 1998 Russian financial crisis, which made the Baltic States aware of the external fragility of their economies, acted as a direct push towards the creation of an active innovation policy in Estonia. However, the most important external factor was EU accession, which required countries to design their own national development strategies. These factors have strongly influenced the shape of innovation policy and the scope of its instruments, leading to so-called "Europeanisation".

The positive effects of the Europeanisation of innovation policy are twofold. First, science/innovation policy is likely to become less bureaucratic and more transparent (efficiency and effectiveness argument). Second, Europeanisation will lead to the integration of local RTD excellence into EU-wide RTD networks (integration argument). The experience of South EU economies shows that Europeanisation has had the strongest impact on the definition of problems and the choice of policy tools. We may expect that this dimension of Europeanisation will have ambiguous effects in the CEECs.

However, Europeanisation might also lead to some negative effects. First, a myopic perspective of national RTD policy through the mechanical transfer of policy models from the "EU shelf" may lead to the neglect of production capability issues. As indicated above, this aspect may be essential for closing the productivity gap. Second, Europeanisation may widen the gaps in national innovation systems by widening the gap between highly globally

[4] See Trendchart Innovation Policy Reports at www.cordis.lu/trendchart.

integrated but locally irrelevant pockets of scientific excellence and standalone traditional and innovation-averse SMEs.

In order to be effective, innovation policies in the CEECs should recognise the structural weaknesses of their individual innovation systems. Among the common structural weaknesses of the CEECs' innovation systems, the most important are the following:

- Innovation activity is restricted to a few large domestic enterprises that invest a comparatively high share of sales into innovation;
- SMEs are the weakest part of the innovation systems, as shown by a very small share of innovative SMEs (with the exception of Estonia);
- Foreign firms are investing comparatively more into R&D and innovation than are domestic firms. This, together with the higher capital productivity of foreign firms, leads to large productivity gaps between domestic and foreign firms in a majority of the CEECs (with the exception of Slovenia);
- Very weak linkages between domestic large enterprises and SMEs, and between FDI and domestic firms, lead to fragmented innovation systems;
- Production capability is the crucial area of company technology effort in the majority of the CEECs, while the existing S&T infrastructure is geared primarily towards technology (R&D) capability and very often unrelated to the significantly changed demands of local firms.

In order to address these structural weaknesses, new member and candidate states will have to search for their own innovation policy solutions, as opposed to the rather imitative mode that has so far prevailed.

The early to middle 1990s saw the focus of innovation policy in the CEECs to be much on so-called bridging institutions (academy-industry relations, S&T parks, commercialisation issues). This policy implicitly assumed that public R&D, financing and demand for innovation were not the problem but the link between them was, so the policy problem was primarily seen as a problem of informational and financial mismatches between supply and demand for R&D. The supply of R&D was not considered a problem, as there was a widespread belief that there was a large pool of inherited R&D and technology potential "ready" to be commercialised. The neglect of production capability as a policy issue (except in Slovenia), of firms as a source of supply of technology, led to "surrogate modernisation" or mechanical transfer of "best policy solutions" that did not really make a difference in practice. As a result, we saw "bridging failure" but primarily due to "agent failure". By the latter we mean enterprises that did not embrace innovation and that were very weak as innovation agents.

This was the result of the collapse of domestic demand for capital goods until the mid-1990s and the collapse of demand for R&D through the downsizing and break-up of large firms, which are in all countries the key source of in-house R&D. Instead of the "in-housing" of R&D, i.e. the integration of extramural R&D groups into large firms, we saw the closure of intra-firm R&D departments[5]. The differences between countries in this respect were directly related to their degree of socialist heritage (in terms of the degree to which CEE firms were organised as business organisations vs. organised primarily as production units with "outsourced" R&D).

Public R&D organisations that faced the collapse of R&D demand from industry, which in some countries was quite developed through contract R&D, had to resort to a variety of micro-strategies in order to commercialise their R&D capital. This was done through various spin-offs and by extending the scope of their activities towards commercially attractive

[5] These have been re-established or re-scaled again in the early 2000s in a few old CEE blue-chip companies.

activities, such as consulting and other services (measuring, testing, trading, renting). Overall, these effects were limited and did not turn these organisations into viable commercial entities.

A market for “bridging services” did not develop, due to mismatches of supply and demand. Industry, which has needs for “problem-solving skills”, was faced with knowledge providers that were trying to commercialise what they considered “R&D solutions ready for commercialisation”. New-technology-based firms (NTBFs), which were seen as the natural carriers of the commercialisation of R&D results, faced a variety of marketing, technical and financial barriers. Although in each of the CEECs we come across several success stories, their number has turned out to be disappointingly low and hence NTBFs have not become a sector that can be considered a standalone source of growth. Despite political support expressed for the concept of NTBFs, this was not matched by significant policy measures. The legal and administrative framework for high-tech start-ups faces a variety of problems in IPR valuation, protection, and commercialisation support that is underdeveloped. Private financing, especially seed capital for NTBFs, is underdeveloped in all of the CEECs. Public funding has mainly been geared towards incubators, with much less focus on services provided to start-ups.

In the late 1990s and early 2000s, we have seen differentiation among the CEE countries in the scope of innovation policy. These differences reflect several criteria: first, the degree to which individual countries’ innovation policies are re-focusing towards production capability and a broader productivity improvement agenda; second, the degree to which innovation policy is oriented towards FDI; third, the degree to which policy focuses on R&D *in* industry vs. R&D *for* industry; and fourth, the degree to which countries have established explicit innovation policy or to which innovation policy could be considered implicit, i.e. as ad hoc programs and support mechanisms without explicit reference to innovation policy strategy. As a result, we can observe an increasing differentiation among the innovation policies of the CEECs, as some of the chapters in this volume also confirm.

However, despite increasing differences in innovation policy, all new member and candidate states still share weak and disorganised actors in favour of innovation policy. This does not work well for innovation policy, which, unlike for example macroeconomic policy, is essentially an inter-sectoral activity and of a multi-dimensional nature. The innovation policy constituency is dispersed and thus difficult to self-organise. Hence, innovation policy is rife with coordination, aggregation and critical-mass problems. Similar to trade policy, it abounds with the problems of the “logic of collective action” type.

So far, innovation policy has enhanced and expanded a weak and dispersed innovation constituency in new member and candidate states. However, it is not yet clear to what extent this has led to a layer of “intermediate bureaucracy” or “innovation constituency”. The key problem of innovation policy is how to enlarge its scope from that of mainly research to that of a broad productivity agenda. In the final section, we try to address the key challenges for innovation policy.

4. Conclusion: Key Challenges for Innovation Policy

This chapter has summarised the key issues of innovation policy in the CEECs. The recovery and growth of the CEECs has not led to the automatic recovery of demand for R&D and technology. Innovation processes in the CEECs still seem very much focused on the mastery and use of machinery and equipment, with a limited R&D component. Technology effort in the CEECs is still very much concentrated on the mastery of production capability, with important policy implications.

Innovation policy has only recently re-emerged in the CEECs, after having been relegated to a secondary role during the transition process. The early to middle 1990s saw the focus of innovation policy in the CEECs to be much on so-called bridging institutions (academy-industry relations; S&T parks; commercialisation issues). Overall, the effects of these policy efforts have been disappointing due to several factors that were explained above.

In order to be effective, innovation policies in the CEECs should recognise the structural weaknesses of their individual innovation systems. This will require a search for country-specific solutions, as opposed to the rather imitative mode that has so far prevailed.

There are various specific issues that could be highlighted as key challenges[6]. Here we point to two policy challenges that could be considered common to all of the CEECs. First, R&D/high-tech is still the dominant paradigm in innovation policy in the CEECs, despite data that suggests that innovation in these countries is very much linked to equipment and has a limited R&D component. This leads to a very narrow "client base" of innovation policy and to the neglect of huge untapped demand related to quality, diffusion and knowledge absorption. How innovation policy can contribute to the productivity agenda by expanding on absorption and diffusion remains a policy challenge.

Second, the CEECs are very much FDI-dependent economies, which innovation policy has not taken into account. Innovation policy is dominantly focused on national systems of innovation, while productivity improvements and FDI follow value-chain logic. The key challenge is how to reconcile and integrate these two policies. FDI policy is usually concerned with location investments, irrespective of the extent and depth of FDI technology. FDI policy is concerned with how to market a country for FDI, while innovation policy is exclusively focused on the R&D/high-tech segment of the economy. The issue is how to ensure and integrate these two policies. Those countries that will manage to conform to EU and WTO requirements, while simultaneously leveraging FDI in promoting their national and regional systems of innovation, will be future success stories. We can hope that some of the South East European economies will learn from the past experiences of the rest of the CEECs and catch up in innovation policy, to the benefit of their citizens and their countries' welfare.

References

[1] Berg, Andrew; Borensztein, Eduardo R; Sahay, Ratna; Zettelmeyer, Jeromin (1999), The Evolution of Output in Transition Economies – Explaining the Differences, IMF Working Paper WP/99/73.

[2] Cohen, W. M. and D. Levinthal (1989) "Innovation and Learning: The Two Faces of R&D", *Economic Journal*, Vol. 99 (397): 569–96.

[3] Cohen, W. M. and D. Levinthal (1990), "Absorptive Capacity: A New Perspective on Learning and Innovation", *Administration Science Quarterly*, Vol. 35 (1): 128–152.

[4] EC (2002), *Innovation Policy in Six Candidate Countries: Hungary, Slovenia, Estonia, Poland, Czech Republic, Cyprus*, EC DG Enterprises, Innovation Studies, Luxembourg.

[5] EC, (2003), *Innovation Policy in Seven Applicant Countries: Challenges*, EU DG Innovation, EC Printing Office, Luxembourg.

[6] EC (2004) Commission Recommendations on the 2004 Update of the Broad Guidelines of the Economic Policies of the Member States and the Community (for the 2003–2005 period) (presented in accordance with Article 99(2) of the EC treaty), *Brussels, 7.4.2004, COPM (2004)238.*

[7] EU (2003), *2003 European Innovation Scoreboard*, Luxembourg, www.cordis.lu/trendchart

[8] Fischer, Stanley; Sahay, Ratna; Vegh, Carlos (1998), From Transition to Market – Evidence and Growth Prospects, *IMF Working Paper,* WP/98/52.

[9] Havrylyshyn, Oleh (2001) Recovery and Growth in Transition: A Decade of Evidence, *IMF Staff Papers*, Vol. 48, Special Issue, Washington, IMF, pp. 53–87, http://www.imf.org/external/pubs/ft/staffp/2001/04/pdf/havrylys.pdf

[6] For an extensive account of these policy issues, see EU, 2003b.

[10] Radosevic, S. and L. Auriol (1999), Patterns of Restructuring in Research, Development and Innovation Activities in Central and Eastern European Countries: Analysis Based on S&T Indicators, *Research Policy*, 28 (1999) 351–376.
[11] Zukowski, R. (1998), From Transformational Crisis to Transformational Recovery: The Case of Poland's Industries, *Economic Systems*, Vol. 22, No. 4, December 1998, pp. 367–397.
[12] EU (2002), *2002 European Innovation Scoreboard*, Luxembourg, www.cordis.lu/trendchart.

PART II

Country Science and Technology Policy: An Overview

This page intentionally left blank

Modernisation of Science Policy and Management Approaches in Central and South East Europe
E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 6

Science and Technology in the Republic of Croatia

Dr. Nada ŠVOB-ĐOKIĆ
Institute for International Relations, Zagreb, Croatia

Abstract. This text offers a short overview of S&T capacities in the Republic of Croatia. In the transition period (from 1990 on), S&T capacities have generally declined, due to reduced investments and slow and inadequate restructuring of the sector, which caused heavy brain-drain and worsened material conditions for research. Conceptual frameworks for the restructuring and development of S&T still remain unclear, which enables oscillations and radical changes in the treatment of the S&T sector by different Croatian governments. Priorities are being changed often, or remain undefined, and fluctuations in investment and turnover in proclaimed institutional reforms are typical. The text concludes with the strong recommendation that an S&T policy should be clearly formulated, publicly proclaimed and implemented, which would position S&T as a development priority for the country.

1. Introduction

Croatia is a country of about 4.4 million inhabitants, 8.9% of which have a university degree. There are about 140,000 students in six universities (Zagreb, Rijeka, Osijek, Split, Zadar and Dubrovnik), and about 7,000 professional researchers and university professors. About 200,000 young people complete their secondary education each year.

GDP per capita reaches 5,056 USD (2002), which in real terms amounts to 87% of the GDP per capita from 1989. The main social and economic problems are largely the result of transition processes and the war that occurred with the dissolution of Yugoslavia. Unemployment has grown heavily (18.3% in 2002) due to the decrease of industrial production and problematic privatisation. General slow restructuring of the economy and a low level of exports have resulted in a trade imbalance and the rather high foreign debt of the country.

In such a situation the social and developmental role of science has not been sufficiently appreciated. The objective problems of transition and social and economic restructuring of the entire research and development field were matched by a number of ill-thought and arbitrary decisions and solutions that were often counterproductive. At the end of 2003, Croatia is again in a position to redefine its scientific policies and consider new priorities in scientific development.

2. The Period of Transition

Since 1990, Croatia has been experiencing typical transitional problems in the field of science and technology. The overall decline in scientific research appeared as a consequence of a radical decline of investments in science and technology, parallel to the slow restructuring and reorganisation of the whole sector. This decline most drastically affected applied and experimental research, which is connected to the fall of industrial production and the bankruptcy and destruction of several thousands of enterprises. Science withdrew from the production processes and closed itself in specialised scientific institutions. Rather heavy brain-drain accompanied this process. In about ten years, the number of scholars, scientists and researchers was reduced by about 25% to 27%, and brain-drain increased significantly [1]. Research work became increasingly difficult because of inadequate material conditions (reflected particularly in low wages and obsolete equipment), but also because of a thoughtless and ill-conceived institutional reorganisation, which increased the marginalisation of research and scientists.

The lack of elaborated scientific policies, as well as of sufficient developmental policies that would provide a framework for supporting scientific development, indicate that the primary problems of scientific transition are those of “vision, conceptualisation and even intellectual attitude, and only then theoretical and technical problems” [2]. This is reflected in all aspects of research and development transition in Croatia.

3. General Public Understanding of Science and Technology Activities in Croatia

There are three main attitudes that illustrate the general understanding of science and technology activities in Croatia:

- A form of prestigious consumption;
- A basis for higher education;
- A function of technological development.

Understanding science as a form of prestigious consumption is inherited from the socialist system. Scientific institutions, universities and scientists enjoyed certain social privileges based on expectations that science could solve a number of social problems, and that it provided for an easier and more efficient way of reaching certain development goals. This approach reflects a mixture of scientific optimism and hard-core social functionalism, but at one time it served scientific development and brought some valuable scientific results. However, such understanding tended to over-evaluate the power of knowledge, particularly in comparison with other activities and productions.

Science as a basis for higher education and education in general dominates present day approaches in an attempt to create better links between scientific research and higher education, in view of its modernization. This approach stresses the fact that scientists and researchers are mostly concentrated in universities. However, due to the very difficult situation in education and the inability to carry on with its necessary reforms, the sciences play a marginal role in education and at the universities. It could even be said that this approach tends to marginalise many possibilities offered by research and knowledge.

Science as a function of technological development gains ground with the restructuring and modernisation of the economy. The process is very slow and in many aspects inadequate, but there are some examples of success that encourage a realistic approach to the professionalisation of research and functionally linking research and development. This approach stands for the involvement of some universities and their research potential and helps to promote functional links between successful already privatised and internationalised companies (e.g. the pharmaceutical company “Pliva”, communications company “Ericsson Nikola Tesla”, etc.) and the scientific and research sectors. It clearly stresses the usefulness of knowledge and supports the various possibilities of its developmental usage.

4. Basic Conceptual Considerations

The treatment of R&D and the general position of scientific research and scientific development in Croatia may be summarized in answers to the following questions:

- Why would a small transitional country like Croatia support and develop scientific research?
- Should Croatia downgrade scientific capacities?
- Should Croatia upgrade scientific capacities?

Answers to these questions depend on the general political attitude of governments regarding the development of the country. In about the last fifteen years of Croatian history, these attitudes have varied considerably. Since Croatian independence, a lot of lip service has been paid to science and scientific development, but investments in science have been constantly and radically lowered. Institutional reorganisation aimed at downsizing the scientific sector, extracting research institutes from universities and closing research capacities in large enterprises. All this proved to be counterproductive for the development of scientific research. In the public debate about science it was constantly stressed that it is costly, inefficient and disorganised. The result was a complete marginalisation of scientific research and development.

A conceptual change appeared with the political changes in 2000. Although Croatia is a small country, it should not downgrade its already limited scientific capacities. Scientific policies should become more transparent, and the sector should be reorganised starting with the introduction of the new Law on Research and Higher Education, which should provide for reforms that would enable the introduction of European standards. Investments in the scientific sector should grow and the R&D sector needs to be treated as a sector of major developmental importance for the country, which needs to enter a post-industrial knowledge-based society.

Unfortunately, not much of this conceptual framework has been realised and applied. However, some reforms were launched, and an increase in investments was recorded. These weak and vulnerable changes have again been stopped by new developments: change of political power and suspension of the new law, as well as reorganisation of the administration; the Ministry of Science and Technology has been merged with the Ministry of Education, which has practically stopped all reforms and made normal functioning of the whole sector difficult. The chances to increase funds for research and development are practically nil in a situation in which the government proclaims other priorities.

5. Investments in the S&T Sector

Croatian investments in the S&T sector lag behind most European countries, including the transitional ones. Gross expenditure for research and development as a share of GDP (GERD) is as follows:

Table 1. Gross Expenditure for Research and Development as a Share of GDP (GERD).

	GDP (in millions of $)	**GDP per capita (in $)**	**Gross Expenditure for Research and Development as a Share of GDP (GERD)**
1999	19,906	4,731	0.98
2000	18,427	4,206	1.23
2001	19,536	4,403	1.09
2002	22,436	5,057	–

Source: State Statistics Bureau, 2003

Table 2. State Budget Expenditure in 2003.

	Kunas	**€**
Total	2,789,354,701	367,988,747
Science: 29.1%	811,193,013	107,017,548
Higher Education: 60.7%	1,692,760,065	223,319,270
Other: 10.2%	285,401,623	37,651,929

Source: Ministry of Science and Technology, 2003

The extra-budgetary funding of science remains non-transparent. According to some recent assessments, it reaches an average of about 20% of the budgetary allowances per year.

The Ministry of Science and Technology financed the following contracted projects from 2002:

Table 3. Contracted Research and Development Projects by Scientific Field, 2002.

- Natural sciences 18% = 311 projects
- Engineering sciences 20% = 334 projects
- Biomedical sciences 24% = 404 projects
- Biotechnical sciences 10% = 163 projects
- Social sciences 14% = 237 projects
- Humanities 14% = 252 projects
- Total: 1,701 projects

Source: Ministry of Science and Technology, 2003

6. Scientific Capacities

Croatia has six universities, two of which (in Zadar and Dubrovnik) have been established in 2002 and 2003. Twenty-six public research institutes are managed by the present Ministry of Science, Education and Sport. Eleven company institutes are either new or recently restructured research centres functioning in different technical and professional fields. There are three academies, the most important being the Croatian Academy of Sciences and Arts (CASA), which includes nine professional specialised departments and nineteen research units. Croatia also has a military research institute, IROS, specialising in defence and security systems R&D.

This research infrastructure would be able to serve well the research and development needs and possibilities in Croatia if it were well organized and well equipped. The present state of its functioning is not always reliable, which often discourages researchers and research teams.

7. Human Potential

There are about 7,000 professors and researchers involved in different research activities in Croatia. The human potential in R&D activities in public research institutes amounts to about 1,500 researchers.

Table 4. Human Potential in Public Institutes.

- Senior research fellows: 13% = 188
- Senior research associates: 10% = 149
- Research associates: 15% = 196
- Research assistants: 13% = 228
- University graduates: 13% = 188
- Other employees: 36% = 517
- Total: 1,475

Source: Ministry of Science and Technology, 2003

There is a special program for employment of junior research assistants in the universities and research institutes. It is subsidised by the Ministry, and encompasses about 2,500 young researchers in universities and research institutes. The distribution of junior research assistants by scientific discipline is as follows:

Table 5. Distribution of Junior Research Assistants by Scientific Discipline (end of 2002).

- Natural sciences: 22%
- Engineering sciences: 24%
- Biomedical sciences: 17%
- Biotechnical sciences: 8%
- Social sciences: 16%
- Humanities: 13%

Source: Ministry of Science and Technology, 2003

8. Technological Infrastructure and Projects

In an effort to revive technological research and application of knowledge, the ex-Ministry of Science and Technology supported the development of technological and R&D centres. The largest is the Croatian Business and Innovation Centre (BICRO) in Zagreb, while six other centres are either regionally or professionally specialised: Technological Centre, Split; Research and Development Centre for Mariculture, Dubrovnik; Technology Transfer Centre, Zagreb; Production Procedure Centre, Zagreb; Innovative Technology Centre, Rijeka; and Technology Development Centre, Osijek.

A number of technological projects were supported from the budget of the Ministry. The largest support was offered to technological research in the fields of engineering sciences (48%), biotechnical sciences (13%), biomedical sciences and health (28%), and other (11%).

9. Primary Aims of S&T Policy

The basic documents that treat issues relevant for defining S&T policy are: a part of the strategy *Croatia in the 21st Century* devoted to science and technology and adopted by the

Parliament in 2003; *The Law on Research and Higher Education*, passed in June 2003, and suspended by the beginning of 2004, as well as the *Program for the Innovative Technological Development of Croatia*, adopted in 2001. All these documents represent a framework in which the primary aims of science and technology policies have been defined during 2003. The first on the list of primary aims was the restructuring of the science and technology sector, followed by the increasing of investments in S&T and diversification of financial resources. Regional diversification of infrastructure and research used to be of high priority. It resulted in the establishment of two new universities and in providing of infrastructure for new research institutes, including international ones, e.g. the Mediterranean Institute of Life Sciences (MedILS) in Split. The upgrading of science and technology through international scientific cooperation was also high on the list of priorities, and it resulted in the reorganisation and restructuring of international cooperation, with the aim of supporting the move from bilateral to multilateral research programs and providing for more flexible financing of programs.

The absence of a clearly formulated, coordinated and publicly proclaimed science policy in Croatia reflects the fact that the position of science in Croatian society and its development is not clearly defined [3]. This prevents successful reforms in the scientific and higher education sectors and exposes the science and technology field to constant and mostly unqualified external interventions. Excessive influence of the state and state budget marginalises the position of science and deprives the whole sector of its creative and flexible development, through which it should encompass holistic practices linking together science, technology, higher education and elements of other human activities. In this respect, some kind of balanced diversity is needed, as well as a more professional management of the science and technology sector.

References

[1] Prpić, Katarina. Size, Structure and Dynamics of R&D Personnel. In: N. Švob-Đokić (ed.), Research and Development Policies in the Southeast European Countries in Transition. Republic of Croatia. Zagreb, 2002, pp. 46–73.

[2] Aligica, Paul Dragos. Neoclassical Economics and the Challenge of Transition: Lessons and Implications of the Eastern European Economic Reform Experience, IMW Working Paper No. 3/2003. Vienna, 2003, p. 11.

[3] N. Švob-Đokić (ed.). Research and Development Policies in the Southeast European Countries in Transition. Republic of Croatia. Zagreb, 2002, p. 115.

Modernisation of Science Policy and Management Approaches in Central and South East Europe
E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 7

Science and Technology Status in Bosnia-Herzegovina

Dr. Lamija TANOVIĆ
Department for International Scientific, Technical, Educational and Cultural Co-operation, Ministry of Foreign Affairs, Sarajevo, Bosnia-Herzegovina

Abstract. A description of Bosnia-Herzegovina's Science and Technology sector is given. Due to the lack of reliable statistics, it is merely qualitative rather than quantitative.

Bosnia-Herzegovina is situated in a part of Europe that has been labelled throughout history as a region of unrest, complications and constant perturbation. It is usually called the Balkans or South East Europe. And, to be honest, during the past 10 to 15 years this region has suffered a series of shocks such as the fall of the socialist system in Bulgaria, Romania, Albania and ex-Yugoslavia. After prolonged armed fighting, Yugoslavia was divided into five fragments. The consequences of this have been mass destruction, displacement of population and huge casualties.

Only in the last few years, a considerable effort has been made in this region to catch up with the advancements that have taken place in Europe and to join European integration. Higher education and science and technology sectors in the region are also moving in this direction.

Introduction

The 1990s brought both war and independence to Bosnia-Herzegovina. War had a disastrous effect on scientific institutions and higher education in Bosnia-Herzegovina. Funding was all but cut-off, infrastructure could not be maintained and scientific and international co-operation projects could not be sustained.

The war also caused many of the best scientific minds, not to mention young researchers, to leave Bosnia-Herzegovina and head to countries where the conditions, facilities and pay were much better. Universities in Bosnia-Herzegovina are still being used primarily at the undergraduate level and not in a postgraduate capacity. Part of the reason for the poor state of the science community in Bosnia-Herzegovina is that international aid, following the war, did not allocate funds to science but rather to the construction of institution buildings, rehabilitating health services and mine clearance. This means that the facilities of the scientific community received little or no help in recovering from the damage and "brain drain" brought about by the war.

1. Some Statistics

The basic criterion used for estimating the scientific and technological development of Bosnia-Herzegovina is the competitive capability of the state. This is because Bosnia-Herzegovina is a small, economically marginal country and has not yet reached economic sustainability. The Global Competitiveness Report (GCR) of The World Economic Forum has observed and ranked the competitiveness of 59 countries from a number of continents. The countries are ranked based on 184 criteria divided into 8 relevant groups. Bosnia-Herzegovina is not among these countries, but our experts have made a study using the same methodology and have ranked Bosnia-Herzegovina among these 59 countries.

For spending on research and development, 0.05% of the GDP, Bosnia-Herzegovina ranks as 56th, between Indonesia and Ecuador. Based on the number of Internet hosts per one million inhabitants (950 in Bosnia-Herzegovina), Bosnia-Herzegovina is in 37th place, between Russia and Costa Rica. According to the number of PCs per one thousand inhabitants, Bosnia-Herzegovina would be 40th, between Bulgaria and Colombia.

Bosnia-Herzegovina does not have any science funds whatsoever. Expenditures are periodical and minor (the percentage of the GDP allocated to research is between 0.3% and 0.5%, which is, admittedly, a trifle when compared with the EU average of 1.9%).

Shortly before the war, 1.5% of the GDP in Bosnia-Herzegovina was spent on research and development. Further, if we take into consideration that in the year 2001 the GDP in Bosnia-Herzegovina was approximately 40% of that from 1990, we come to the conclusion that the total research and development spending in Bosnia-Herzegovina at present is meagre.

Training conditions are poor and equipment is very scarce. Owing to the fact that the research infrastructure has been either destroyed in the war or is outdated, university professors have not been able to pursue scientific work at an appropriate level, which is the basis of high-quality university education. At the same time, our country is facing many other problems more urgent than that of higher education. Therefore, education and science are at the last place on the priority scale for reconstruction. In a country like Bosnia-Herzegovina, where the GDP per capita is below 1500 USD, and the unemployment rate about 40%, one cannot expect much for the sectors of science, research and higher education.

Bosnia-Herzegovina has greatly suffered from the war that lasted from 1992 until 1995. In the last eight years, the international community, which supervises the reconstruction and recuperation of Bosnia-Herzegovina, has had its priorities. Unfortunately, these priorities did not include the sectors of science, research and technology.

The reform of the education system in Bosnia-Herzegovina has finally appeared on the agenda this year. Still, the reconstruction and reform of higher education are not thorough enough. Four countries from the region, including Bosnia-Herzegovina signed the Bologna Declaration in September 2003, which presents the start of reforms aiming to bring them closer to the European Higher Education Area.

After the appropriate reforms have been carried out, higher education could be an important factor in the development of this part of Europe as well as in the development of civil society. Socialist society did not have any experience with decentralized authority or civil society, but it held a very clear position as far as education was concerned. During socialism, in a society where private property did not exist, the only heritage that parents could provide for their children was education, which was free. This is why education was valued so much in this society, and the most cherished dream of parents was to enable their children to obtain a university diploma. People still tremendously value education in this part of the world, which is why a free and autonomous university would be a perfect basis for the development of civil society and independent thought.

Table 1. Overview of Bologna Process Implementation in the Region.

Country	**Lisbon Convention** Signed (Date)	**Lisbon Convention** Ratified (Date)	**Lisbon Convention** Put into Operation	**Bologna Declaration** Signed (Date)	**ENIC Set Up**	**ECTS Set Up**
Albania	4.11.97	6.3.02	1.5.02	19.09.2003	–	no
B&H	17.7.03	–	–	19.09.2003	no	no
Bulgaria	11.4.97	19.5.00	1.7.00	19.6.1999	yes	yes
Macedonia	11.4.97	29.11.02	1.1.03	19.09.2003	yes	yes
Romania	11.4.97	12.1.99	1.3.99	19.6.1999	29.1.99	yes
Serbia and Montenegro	–	–	–	19.09.2003	yes	no

2. Brain-Drain

Our region suffers from a drastic case of "brain-drain". My country, Bosnia-Herzegovina, has lost almost 30% of its population as a consequence of the war. This is hard to prove, as there has been no census since 1991. However, estimates say that 250,000 people have been killed or are missing and more than 1 million have been forced to leave the country. A recent poll among youth, university and high school students revealed that 62% of them wish to leave the country. My personal estimate is that in the past 10 years, 70% of my colleagues, university professors and researchers from the institutes, have left the country. The reasons for this are the unfavourable work conditions at the universities, lack of research capacity and impossible conditions for research work. Bosnia-Herzegovina is of course an extreme example, having suffered through a very difficult period during the past ten years. However, the situation is quite similar, although somewhat better, in Bulgaria, Albania, Macedonia and Serbia and Montenegro. Statistics say, for example, that Bulgaria has lost 10% of its population in the past decade. According to UNDP sources for the year 2000, in the period from 1990 to 1999, 40% of researchers from universities and research centres left Albania, and 67% of them received their Ph.D. abroad. Also, according to the same poll, 63% of researchers working in the country at present are planning to leave.

The progress of our society depends largely on whether we will be able to keep younger generations in the country. This can only be accomplished if higher education reforms are carried out, making higher education comparable with education in the developed parts of Europe.

3. Problems

Much of the R&D infrastructure and equipment was destroyed during the war and what little managed to survive the devastation is now outdated. A financing system for science and research has not been established either in the entities or in the cantons or regions. This fact has very detrimental consequences:

1. The Universities have become akin to high schools and have no systematically incorporated science and research, with the following additional negative side effects:
   - The quality of the university diploma is questionable;
   - Graduate students are of low quality and could hardly be expected to lead the country towards economic recovery;
   - The most talented students are no longer attracted by the possibility of a university career and instead wish to leave the country.
2. A very high percentage of R&D units have ceased to exist or have been transformed, degraded and re-orientated towards routine services, with the following consequences:
   - "Brain-drain" – the departure of capable researchers;
   - Lack of young researchers;
   - Lack of results from own research efforts;
   - Low possibilities for international co-operation, so that Bosnia-Herzegovina is the most scientifically isolated of all the countries in transition.

3. The Way Out

What are the urgent requirements for Bosnia-Herzegovina that, once fulfilled, can solve the problems listed above?

1. There is an urgent need for the rebuilding and reconstruction of the S&T and R&D sectors (laboratories, equipment and materials).
2. There is a great need for more co-operation inside the country, within the region and with international partners.
3. S&T policy and R&D strategy have to be created (and implemented) on the state level, including:
   - Decision making;
   - General objectives for S&T policy;
   - Main legal provisions in the S&T field;
   - Network of S&T institutions;
   - Human resources – employment in the S&T sector;
   - Reconstruction and building up of the research infrastructure;
   - Revitalisation of scientific institutions and research capacities;
   - Investment in education and high-level training of young researchers and scientists.
4. R&D co-operation priorities should include the following:
   - Environment;
   - Energy efficiency;
   - Agriculture and food processing;
   - Public health;
   - Industrial technologies for the reconstruction of the country (materials-related technologies).

4. Conclusion

The previous pages represent a mostly qualitative description of the state of the S&T and higher education sectors in Bosnia-Herzegovina, seeing as the universities are still the major centres for science and research. I have also listed the priority steps that should be taken in order to revitalise the S&T sector. I believe that it is very important to emphasise how and in what order these priorities should be tackled.

First and foremost, reconstruction of the research infrastructure is *sine qua non* for the revitalisation of the research sector. Without this reconstruction we cannot even approach the other priorities in this process. However, in a country where the GDP per capita is under 1500 USD and the unemployment rate is approximately 40%, it is unrealistic to find the funds in state or regional budgets necessary for the reconstruction of the research infrastructure. In a situation like this, the development of science and technology seems to be a luxury in comparison with other state priorities.

On the other hand, access to other resources (such as the Frame Program) that would provide funds for scientific projects is impossible without better research equipment and renewed laboratories. Even the possibility of co-operation with other institutions in the region and further abroad is questionable unless the research infrastructure and human research potential is brought to a level comparable with at least the less developed parts of Europe. This, again, is possible only with the help of some sort of “Marshall Plan” in the sector of science and research in Bosnia-Herzegovina. Namely, financial aid and various activities of the international community are already present in many sectors (a large amount of funds have been collected and implemented in various areas of life in Bosnia-Herzegovina), and they should be made to include the sector of science and research. In other words, there is no chance of improving this sector without foreign funds. If reform in the area of science and research is not carried out, Bosnia-Herzegovina will lose what little human potential is left in this area and it will be very difficult, if not impossible, for it to join the European Research Area and the European Higher Education Area, which are two of the most important steps on the way to European integration.

E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 8

Science and Technology Policy in Serbia and Montenegro

Dr. Đuro KUTLAČA
"Mihajlo Pupin" Institute, Science and Technology Policy Research Centre, Belgrade, Serbia and Montenegro

Abstract. Since 1980, the R&D system in Serbia and Montenegro has passed through several phases, from expansion until 1987 through stagnation in 1987–89, regression until 1995, consolidation and a "waiting" period in 1995–98, falling behind in 1999–2000, and transition starting in 2001. In the last 14 years, the R&D system found itself in a very unstable environment. Consequences of the dissolution of the former SFRY – the economic and political isolation of the country and a war in 1999 (which caused destruction of country's infrastructure), devastation of the natural environment, and an extremely poor economic situation – exhausted the economy and society. These unfavourable conditions formed the starting point for the unavoidable transition of the R&D system. The traditional way of policy- and decision-making, which is predominant in the country and also in S&T, preserves the autonomy that keeps the S&T system detached from other segments of the economy and society. Therefore, transition of the R&D system, aside from the restructuring of R&D organisations, includes a substantial change in long-term planning and the adaptation of EU/OECD best practice in S&T policy creation and implementation in Serbia and Montenegro.

1. Introduction

Based on a twenty-year-long time series of available data, the evolution of the research and development (R&D) system in Serbia and Montenegro (S&M) since 1980 can be divided into five phases: (I) expansion until 1987, (II) stagnation in 1987–89, (III) regression until 1995, (IV) consolidation and a "waiting" period in 1995–98, (V) falling behind in 1999–2000, and (VI) transition starting in 2001 [3]. During this period, the role of government support for R&D activities changed drastically, from an engine for development to social welfare. A particularly difficult period, unlike transitional changes in Central and Eastern European Countries (CEECs), started in the beginning of the 1990s with the dissolution of the former SFRY and the subsequent economic and political isolation of the country. This period ended with a war in 1999, which caused destruction of the country's infrastructure, devastation of the natural environment, an extremely poor economic situation, and the demoralisation and impoverishment of the majority of the population [4]. Within this framework, the R&D system struggled to survive, facing a strong "brain-drain" and the absence of needed financial and material support, without communication with the R&D community worldwide. These unfavourable conditions formed the starting point in 2001 for the unavoidable transition of the R&D system. Three years later, in 2004, the R&D community is still waiting for a government policy for restructuring of the R&D system. Unfortunately, the forces of so-called "silent" transition[1] work without control, causing new waves of brain-drain and bringing more uncertainty to the R&D community. Postponement of the restructuring process is damaging to the R&D system, despite the popular belief that "*no restructuring means no troubles, and transition can be avoided – this happened to others, not to us*".

This chapter analyses: (a) an historical overview of the evolution of the R&D system in S&M in the last 20 years, and (b) present S&T policy and future orientation of government support for R&D activities. The qualifications and opinions expressed in this text are the author's perceptions, based on research on the development of the science and technology (S&T) system in Serbia since 1980, and are supported with informal documents due to the absence of formal documents such as national innovation policy or national S&T policy/strategy.

2. S&T System in S&M

The union of the Republic of Serbia and the Republic of Montenegro has limited joint functions and, practically, fully independent R&D systems. The organisational framework of S&T systems in both Republics is very similar, with some differences that reflect peculiar regional and economical differences. The S&T system in the Republics is made up of:

1. Universities – Higher Education Organisations (HEO);
2. R&D or so-called independent Institutes (RDI) – some of them became state-owned institutes after 1990, and some are still socially owned organisations;
3. Research and development (R&D) units (RDU) in industry;
4. S&T infrastructure.

There are several organisations at the union level, like the Organisation for Intellectual Property Rights, Standardization, Measurements and Precious Metals, but all other organisations are under the jurisdiction of Republic administration.

Differences in the size of the two Republics' R&D systems are very strong: more than 95% of the whole system is concentrated in the Republic of Serbia.[2]

2.1. Financing R&D Activities

The distribution of expenses for R&D activities in the country as a share of Gross Domestic Product (GDP) (total – GERD; in GS – Government Sector – GOVERD; in BES – Business Enterprise Sector – BERD; in HES – Higher Education Sector – HERD) is illustrated in Fig. 2.1. Although the total expenses for R&D activities have exceeded 1% of GDP since 1982, the absolute value of the amount spent in this sector was very low in the 1990s, because of a poor economic situation and low GDP. Industry is in a particularly bad situation as a sector with the smallest portion of national R&D resources, never having reached 10% of the national total R&D resources.

The situation in R&D financing activities has slightly improved since 2000: from €12.2 million in 2000 (0.10% GDP), financing from the public budget reached €60.3 million in 2003 (0.32% GDP) (per capita financing changed from €1.57 p.c. in 2000 to €8.05 p.c. in 2003).

[1] A "silent" transition could be described as a change of the R&D system caused by incompatibility between a new economic framework (market economy) and the inherited social, organisational and mental structure of the old, socialist system, without an organised government role that should endorse the directions, conditions and resources for restructuring of the R&D system [2].

[2] During the period 1998–1999, there was some increase in the contribution of the Republic of Montenegro to the total figures for S&M. This came as a result of the migration of scientists from the Republic of Serbia to the Republic of Montenegro due to the strong political pressure on universities and institutes in the Republic of Serbia.

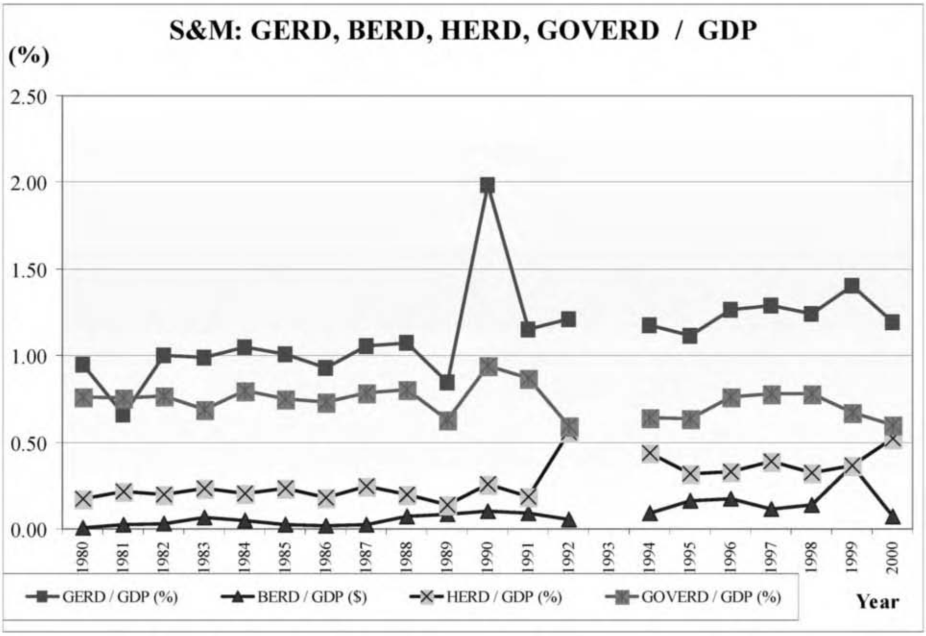


Figure 2.1. R&D Financing in Serbia and Montenegro (S&M) [1].

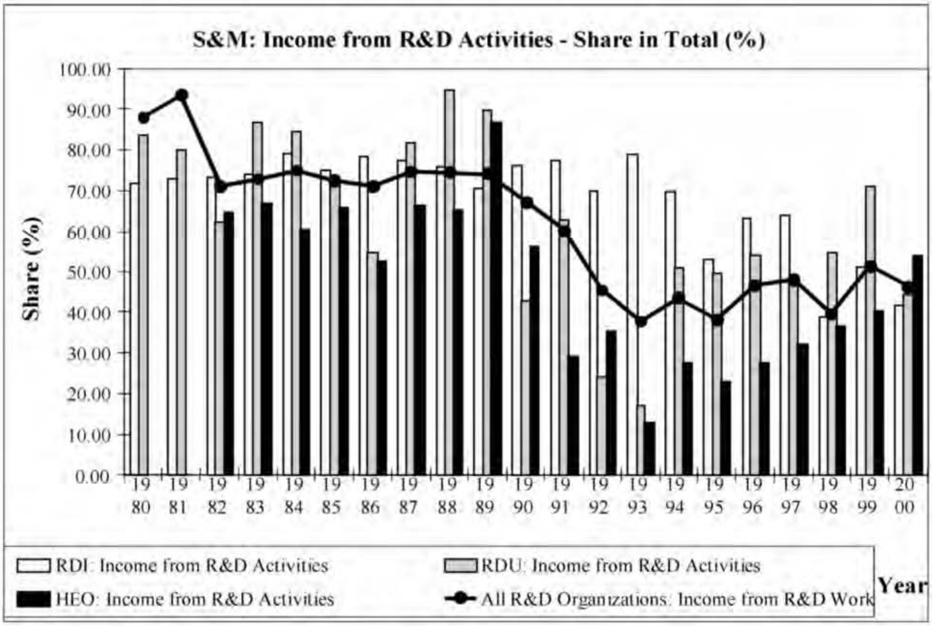


Figure 2.2. Share of Income from R&D Work in the Total Income for the Period 1980–2000 [1].

The share of income from R&D work in the total income of S&M's R&D organisations in 1980–1999 period is illustrated in Fig. 2.2:

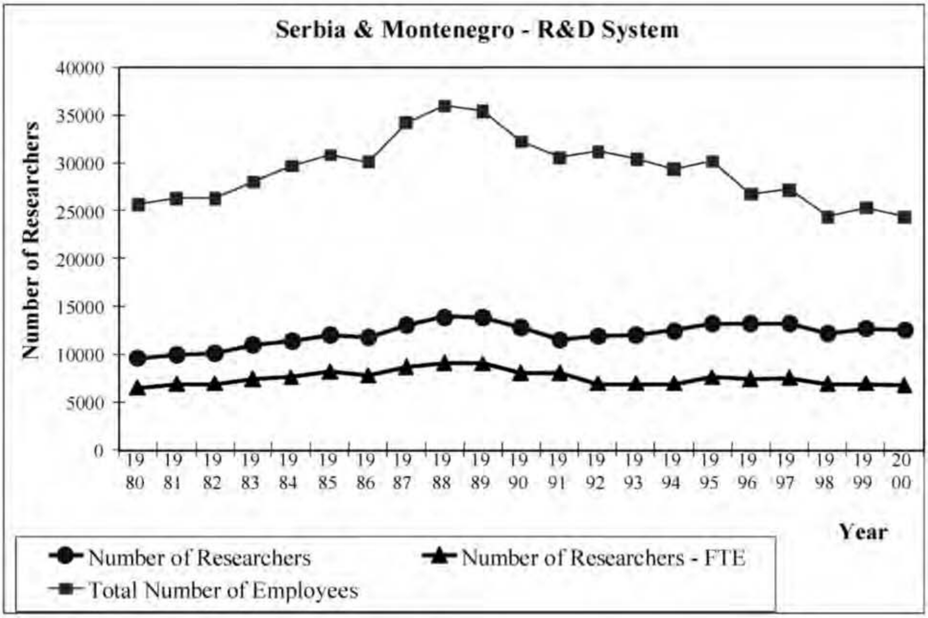


Figure 2.3. Number of Employees in R&D Sector in Serbia and Montenegro, and Total and FTE Number of Researchers, 1980–2000 [1].

1. From 1980 to 1989, R&D work was the basic activity and main source of income of all R&D organisations (70% in RDI, up to 90% in RDU, and up to 65% in HEO);
2. From 1989 to 1995, all organisations within the R&D system were striving to find additional funding sources. The share of income from R&D decreased constantly and in 1993 and 1995 amounted to no more than one third of the total income of RDI;
3. From 1996 to 1999, one can note an increase in the share of income from R&D work in the total income of HEO (up to 40%) and RDU (some 71%), a decrease in RDI to about 51%, and an increase up to 51% in 1999 for the total R&D system due to a growing demand for domestic technologies as a replacement for inaccessible foreign ones.

The decreasing share of income earned from R&D in the total income of Yugoslav R&D organisations since 1989 is *the first indicator of structural changes in the R&D system* (Fig. 2.2); R&D organisations practically changed their operational profile and, in a struggle to survive, began other, non-S&T activities.

2.2. R&D Personnel

The main characteristics of the number and structure of personnel in RDO and changes recorded in the period 1980–2000 (Figs 2.3 and 2.4) are as follows:

1. The total number employed in the R&D system grew since 1980 and reached its maximum in 1988. Since 1988, the number employed was decreasing. The sharp decline in 1991 was caused by brain-drain generated by dissolution of the former SFRY. In 2000, the number employed was 30% lower than in 1988.
2. The number of researchers increased from 9,522 to 13,874 during the period 1980–1988, decreased by 17% during the period 1988–1991, and then started to grow again, reaching 13,220 in 1997. This change is a direct consequence of timely interven-

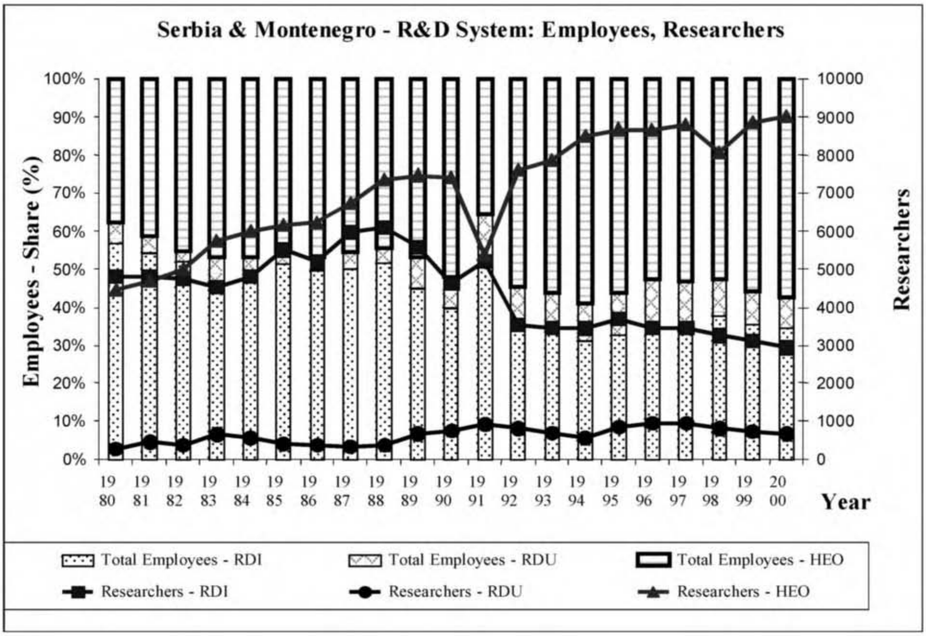


Figure 2.4. Allocation of Employees in the R&D Sector in Serbia and Montenegro, 1980–2000 [1].

tion by the appropriate Ministries, which established programs for the specialisation and employment of young researchers. The worsening of the economic situation and of the status of the R&D system in the country resulted in a new decrease in the number of researchers (as well as the total number employed in this sector).

3. The full-time equivalent (FTE) number of researchers exhibits, however, a trend different from the absolute number during the period 1990–1994 and is *the second indicator of structural changes in the R&D system*: FTE decreased during the period 19(88)90–1992, was relatively constant during the period 1993–1994, and since 1994 has followed the trend of the absolute number of researchers.
4. *The next indicator of structural changes in the R&D system* is a change in the allocation of human resources in all three sectors under consideration (Fig. 2.4): in 1980, of the total number employed in R&D, 56.7% were in RDI (50.4% researchers), 5.6% were in RDU (2.8% researchers), and 37.7% were in HEO (46.8% researchers); in 1999, 35.6% were in RDI (24.6% researchers), 8.6% were in RDU (5.7% researchers), and 55.8% were in HEO (69.7% researchers). A more detailed analysis shows a considerable increase in the absolute number of researchers in HEO (21% more researchers in 1999 than in 1988, i.e. twice that in 1980). At the same time, the absolute number of researchers in RDI decreased and in 1999 accounted for no more than 51% of the figure from 1988.

The change in the structure of employment resulted in the concentration of R&D resources in the HEO sector being considerably higher than the average value in OECD countries and the concentration of R&D resources in the industrial sector being very low (4–5 times lower than the average value in OECD countries). By the end of the analysed period, the RDI sector, which corresponds to the governmental sector under OECD classification, had assumed a share of the national R&D system similar to the average in OECD countries.

5. The strong shift of researchers (from independent institutes and R&D units in industry to universities) recorded during the period 1992–1995 was mainly a result of the search for more secure jobs – university staffs are moderately paid, but without major delays, as was the case in other sectors during that period.

2.3. Summary of Changes in S&T Resources

Analysis of changes in the funding and resource structure of Yugoslavia's RDO indicates that structural changes of the R&D system started during the period 1989–1990 through:

- The individual (i.e. non-organised) transfer of research personnel to HEO;
- The slightly more expressed presence of R&D work in industry;
- A more expressed share of non-research activities in the overall activities of RDO.

Analysis of changes in the fields of S&T during the period 1990–1999 shows the following:

- There has been an increase in the total number of employees in the natural and mathematical sciences, mostly attributable to an increase in university staff accompanied by a decline in the FTE number of researchers;
- There has been a decline in absolute and FTE numbers in the technical and multidisciplinary sciences as the result of a strong brain-drain of researchers;
- In the medical sciences, research activities have been abandoned in some hospitals, and human resources have become concentrated in better-equipped organisations. This field of science suffers from a very strong brain-drain of researchers and also from the emigration of support staff. In 1999, as part of the university in Podgorica, capital of the Republic of Montenegro, the first medical faculty was established;
- The agricultural sciences are a traditional field of R&D in the country, and therefore some brain-drain has been compensated by new recruitment;
- The social sciences show a decline in all three sectors, having become less attractive for employees. The poor economic situation forced many of them to find new vocations;
- As elsewhere, the substantial growth in university staff in the humanities is partly the result of a shift from institutes to faculties, but also the result of the increasing interest of young people in these sciences.

3. S&T Policy

As already mentioned, neither the government of the Republic of Serbia nor the government of the Republic of Montenegro has officially and formally proclaimed any S&T policy in the last several years. Therefore, S&T policy can be recognised through the programmes, mechanisms and instruments launched, financed and conducted in both Republics under the jurisdictions of responsible ministries: the Ministry of Education and Science in the Republic of Montenegro and the Ministry of Science and Environmental Protection in the Republic of Serbia (from 2001 through the beginning of 2004, the Ministry of Science, Technology and Development). Moreover, both Republics have supported R&D activities in the following forms: R&D projects; training and development of human resources for R&D (particularly young researchers); international co-operation; organisation of national S&T congresses and financial assistance for participation in international S&T conferences; publication of S&T journals; building and maintenance of R&D infrastructure (with a primary emphasis on ICT infrastructure); and equipping of R&D organisations with necessary R&D equipment, etc. (all of the programmes and modes of operation in these ministries have been inherited from

Table 3.1. New Government Programs for Support of Technological Development in Serbia, Launched in 2002 (NP – National Programme).

Programme	Universities (Share in %)			Institutes (Share in %)		
	Researchers	Man-Months	Money	Researchers	Man-Months	Money
Technology Development	57.47	53.13	39.85	32.06	36.67	47.95
Energy Efficiency	74.92	73.66	64.41	19.52	19.68	26.07
National Programme (NP) – Biotechnology and Agro Industry	35.04	34.80	31.87	64.96	65.20	68.13
NP New Tech. in Food Industry	92.08	94.06	88.77	0.00	0.00	0.00
NP Technologies for Production of Vegetables, Potatoes and Flowers	67.33	61.65	47.98	32.67	38.35	52.02
NP Technologies for Production of Fruits and Grapes	59.76	62.53	46.40	30.49	29.82	43.32
NP Tech. for Production of Wheat	50.33	55.07	37.71	49.02	42.17	58.76
NP Tech. for Production of Meat	84.29	74.01	58.56	14.29	24.40	39.12
NP Woods	72.32	69.73	56.28	25.00	27.12	38.68
Total	**54.97**	**51.90**	**40.87**	**38.39**	**40.99**	**50.53**

Programme	Industrial R&D Org. (Share in %)			R&D System – Total		
	Researchers	Man-Months	Mo-ney	Researchers	Man-Months	Money (dinars)
Technology Development	10.47	10.20	12.20	3362	16644	471,597,167
Energy Efficiency	5.56	6.66	9.52	666	1758	52,495,358
NP Biotech. and Agro Industry	0.00	0.00	0.00	1524	5946	179,593,589
NP New Tech. in Food Industry	7.92	5.94	11.23	101	438	9,304,976
NP Technologies for Production of Vegetables, Potatoes and Flowers	0.00	0.00	0.00	101	352	9,504,944
NP Technologies for Production of Fruits and Grapes	9.76	7.65	10.28	82	379	10,271,086
NP Tech. for Production of Wheat	0.65	2.76	3.52	153	434	12,557,012
NP Tech. for Production of Meat	1.43	1.59	2.32	70	377	9,544,707
NP Woods	2.68	3.15	5.04	112	413	10,531,490
Total	**6.64**	**7.11**	**8.60**	**6171**	**26741**	**765,400,329**

Source: Ministry of Science, Technology and Development of the Republic of Serbia (website) [5]. Note: €1 ≈ 60 dinars in 2002.

previous times and regimes, with some innovations driven by changes in both the economy and society).

The governments of both Republics dedicated special attention to the support of R&D organisations in their efforts to compete for participation in the EU 6th Framework Programme and to the building of innovation infrastructure, such as innovation centres and technology parks. Further, the government of the Republic of Serbia concentrated its efforts to support technological development activities focused on selected national priorities. These programmes began in 2002 and have continued after political changes in 2004.

The data in Table 3.1 illustrates the distribution of resources (researchers and money) between sectors (HES, GS, BES) and programmes. Structural inefficiency (expressed with concentration of resources at universities) remained in these programmes, too, and changes that could improve this situation cannot be expected before restructuring of the R&D system in the Republic of Serbia. Although both governments announced restructuring as a priority in 2001 and 2004, nothing has happened so far.

4. Summary and Outlook

A brief analysis of past evolution and recent trends in development of the R&D system in Serbia and Montenegro could be summarized with:

I Remaining doubts about the role and modes of functioning of national R&D:

- What model should be preferred: a technology-push (existing) or market-pull approach or a combination of these two models? How to create an effective market-pull environment for the R&D system?
- How to improve inherited weak university-institute co-operative relations?
- How to build operational university/institute-company relations, instead of in reality the fictional, practically non-existent ones?
- What kind of research – basic vs. applied – should be preferred in a country of such size, level of economic development, and available natural resources, etc.?
- How to build a pool for pre-competitive and contract research?
- How to organise R&D in industry that is so weak?
- Which mode of financing of R&D activities should be preferred: project or institutional funding?
- Handling of intellectual property rights (IPRs) within very poorly developed innovation activities.

II Actions already launched and/or planned in order to build the Innovation Society and National Innovation System:

- Promotion of entrepreneurship in technology development (incubators, start-ups, spin-offs, demonstration/application centres, S&T parks);
- Support for more market-driven and application-oriented projects and R&D programs according to the long-term development strategy;
- International collaboration on R&D projects;
- Restructuring of R&D organisations and privatisation in the R&D system;
- Evaluation and benchmarking of R&D organisations, researchers, programmes, etc.;
- Changing the mind-sets (researchers, managers in R&D organisations) and market-orientation of the R&D system;
- Networking and marketing activities in R&D, such as incentives for generic and contract research, clustering of institutes, networking of R&D and other organisations, etc.

Those were the main issues raised during national public discussions in 2002–2003 while both Republics were preparing a new science law and other instruments for the organisation and promotion of R&D activities. Although some of them sound trivial, none of them should be ignored – the fact that they were raised confirms the necessity for serious treatment. Unfortunately, the traditional methods of policy- and decision-making that are predominant in the country, and also in the R&D sector, preserve the autonomy that keeps the S&T system detached from other segments of the economy and society. Therefore, the transition of the R&D system, aside from the restructuring of R&D organisations, includes a substantial change in long-term planning and the adaptation of EU/OECD best practice; the introduction of foresight methodology, methods, techniques and instruments is vital to the process of S&T policy creation and implementation in Serbia and Montenegro.

References

[1] FSO (1980–2000). Statistical Bulletins: Institutions of Scientific-Technological Development. Federal Statistical Office of the FR of Yugoslavia, Belgrade, 1980–2000.
[2] Kutlača, Đ. (1996). The Transformation of the S&T System in Yugoslavia Directed to a New Innovation System, unpublished paper. Wissenschaftszentrum Berlin für Sozialforschung gGmbH, Berlin.
[3] Kutlača, Đ. (2004). FR of Yugoslavia: Restructuring the S&T System – Indicators of Transformation. In: From System Transformation to European Integration: Science and Technology in Central and Eastern Europe at the Beginning of the 21st Century, Werner Meske (ed.), Lit. Verlag Münster, 2004.
[4] UNDP (2001). Suspended Transition: Vulnerability Trends & Perceptions. Background Report, United Nations Development Programme, Federal Republic of Yugoslavia / Republic of Serbia, European Movement in Serbia, Belgrade, January 2001.
[5] www.nauka.ac.yu.

Modernisation of Science Policy and Management Approaches in Central and South East Europe
E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 9

Research and Development (R&D) in the Republic of Macedonia

Dr. Zoran T. POPOVSKI and Dr. Viktor STEFOV
Ministry of Education and Science, Skopje, Republic of Macedonia

Abstract. Scientific activities in the Republic of Macedonia are performed and organised by a network of scientific institutions comprising 3 universities, several research institutes active in various fields and R&D units in industry. Considering the overall political, social and economic conditions the country has faced during the past years, while additionally burdened by instability, the role and position of industry has significantly decreased in the domain of research and development. Despite its difficulties, however, the country has managed to achieve significant results in certain scientific areas.

1. Policy Framework

1.1. Governmental Bodies

According to the Constitution, the state has an obligation to encourage and support the technological development of the country. The governmental body in charge of R&D policy in the Republic of Macedonia is the Ministry of Education and Science, which has the responsibility to organise, finance, develop and promote science, technological development, technical culture, informatics and information systems as well as international cooperation related to these issues. The responsibilities of the Ministry also include issues related to all levels of education.

Scientific activities in the Republic of Macedonia are performed and organised by a network of scientific institutions comprising 3 universities, several research institutes active in various fields and R&D units in industry. An important scientific organisation is the Macedonian Academy of Sciences and Arts, the goal of which is to stimulate development of the sciences and arts.

Within the governmental sector, we should also mention the activities of other ministries: the Ministry of Agriculture, Forestry and Water Supply; the Ministry of Economy, Health, and Ecology; and especially the Sector of European Integration of the Government. According to their strategies, all these bodies act as important subjects related to the research achievements of the scientific community.

1.2. Legal Framework of the R&D Sector

Issues related to R&D are regulated by the following laws:

- Law on the Macedonian Academy of Sciences and Arts;
- Law on Scientific and Research Activities;
- Law on Encouraging and Supporting Technology Development;
- Law on Higher Education;
- Law on Industrial and Intellectual Property Protection;
- Several regulations and instructions.

The laws related to research arrange the system, principles, public interest, forms of organisation and management of these kind of activities as well as the ways of stimulating and supporting their development, scientific personnel and other issues related to them. The system of scientific activities involves scientific research, qualification and training of personnel for research work and research infrastructure.

The basic principles of performing scientific activities are inviolability and protection of human personality and dignity, and they are also based on the following: freedom of scientific creativity; autonomy and ethics of researchers during their scientific work and use and application of the results; diversity of scientific ideas and methods; and international cooperation.

These laws also define the public interest in scientific research in the field of national and cultural identity of the Macedonian people and others living in the Republic of Macedonia. It also determines research as a general condition for the economic, social, cultural and environmental development of the country. Research that serves the function of increasing the scientific level and transfer of knowledge as well as that in the field of defence and security is also defined in this law. Improvements in human resources and research infrastructure are also in the public interest. A five-year programme for development of these activities is being prepared.

The law related to technology development stimulates and supports this kind of development in the country as well as the programming of this activity and its financing. This law defines technology development as:

- Development of own technologies;
- Progress of the country upon an independent economic base;
- Modernisation of existing production capacities;
- Establishment of innovation and technology centres;
- Building of necessary technological infrastructure, and transfer of knowledge through a continuous superstructure of skills.

1.3. Role of the Industrial Sector in R&D

Considering the overall political, social and economic conditions the country has faced during the past years, while additionally burdened by instability, the role and position of industry has significantly decreased in the domain of research and development.

As a result of restructuring and privatisation processes, many R&D units within enterprises have vanished. Present inconvenient financial circumstances do not allow larger investments in research and development.

1.4. Macedonian Research Infrastructure

Macedonian institutional R&D infrastructure is as follows:

- Macedonian Academy of Sciences and Arts, comprising five departments and five research centres;
- Three universities (two public and one private);
- Thirty-four faculties;
- Three higher schools;
- Thirteen public scientific institutes;
- Twenty R&D units within industry;
- Six scientific regional associations;
- Consulting agencies and offices.

1.5. Difficulties in the R&D Sector

During the past decade of transition, R&D policy faced the following difficulties:

- Unsatisfactory level of budgetary, public funds for financing these activities;
- Insufficient S&R infrastructure facilities, equipment and materials;
- Inefficient institutional infrastructure;
- Unsatisfactorily developed mechanisms of transfer of knowledge and research results in the business sector;
- Inconvenient distribution of researchers by sectors (the number of researchers in the business sector is very poor);
- Small investments in applied research and innovation;
- Low level of private investments in R&D sector;
- Unsatisfactory ratio of young researchers in the total number of researchers;
- Serious brain-drain problems.

2. Role and Objectives of R&D Policy in the Republic of Macedonia

Despite the above-mentioned difficulties, the country has managed to achieve significant results in certain scientific areas. There are several distinguished high-level institutes and centres recognized throughout the international scientific community. There are also other research units moving rapidly towards achieving international standards and criteria, which can be competitive and desirable partners in research activities.

The goals of R&TD policy are to:

- Increase the use and transfer of knowledge for economic, social, cultural and environmental development of the Republic of Macedonia;
- Encourage and promote international cooperation and transfer of knowledge and technology from abroad;
- Introduce a monitoring and evaluation system of scientific and technological quality and output of research groups using internationally accepted standards and criteria;
- Increase investments in S&R activities;
- Increase the use of international funds, technical assistance, etc.;
- Define and establish interdisciplinary programmes for target research;
- Set internationally recognized measures for evaluation and assessment of the economic value of research results as criteria for future policy definition;
- Support enterprises in establishing R&D units for effective transfer and use of new technologies;
- Reduce the technological gap in order to reach the level of development of more highly developed countries;

- Create conditions to raise the quality of knowledge and innovation;
- Create a system of technology information as part of a community information system according to the criteria of relevant databases, services and networks;
- Establish a unique infrastructure model to support and develop science and technology;
- Heal and improve domestic industry and companies, and especially support SMEs in order to achieve better performance of their products and make them competitive worldwide;
- Establish a system of priorities that will be supported by economic policy tools.

2.1. Measures Taken by the Government to Develop the R&D Sector and Encourage R&D Activities

The Ministry of Education and Science strives toward the successful transformation of higher education with regard to better transfer of knowledge within the scientific and business sectors.

In order to achieve this, the Ministry has established the following programmes:

- Programme for encouraging and supporting national R&TD projects;
- Programme for granting fellowships for post-graduate and doctoral studies, both in the country and abroad;
- Programme for supporting researchers for participation in international meetings;
- Target research programme for coordination of R&TD activities within governmental bodies;
- Programme for encouraging and supporting technological development for the period 2002–2006;
- Programme for development of R&TD infrastructure.

The Government is trying to provide funds to cover all of these programmes.

3. National Research Priorities

The Ministry of Education and Science has defined and set the following R&D priorities:

- Sustainable development;
- Water resources and management;
- Energy;
- New materials;
- Environment;
- Information and communication technologies;
- Health;
- Biotechnology;
- High-quality food production;
- Earth sciences and engineering.

Special attention will be paid to overcoming problems concerning modernisation of the existing R&D infrastructure as well as building a new one. This comes from several priority tasks, such as to:

- Develop an academic research network;
- Purchase research equipment and foreign professional literature;

- Develop a library information system;
- Support the existing subjects of technological development (public scientific institutions, innovation centres, etc.);
- Establish technology transfer centres to link results from S&R activities with the needs of industry;
- Build or provide space for the accommodation and work of entities that are currently settled in inconvenient locations.

4. R&D Indicators

Since 1998, the methodology of R&D has changed and harmonised with international definitions and standards, according to the Frascati manual. A new approach toward measuring the labour force, i.e. introduction of full-time equivalence (FTE), has been used. Full-time equivalence is the number of persons in paid employment in research-development activity who devote only part of their working time (10% to 90%) to a given R&D activity, estimated by the number of personnel who devote all or almost all of their working time to a given R&D activity.

Table 1. Share of R&D (%) in GDP.

1998	1999	2000	2001	2002
0.2	0.2	0.2	0.2	0.2

In 2001, Macedonian gross domestic expenditure (GERD) amounted to 740 million denars, which was 0.32% of the national GDP. In 2002, it was 0.27%.

Table 2. R&D Intensity (%) of GDP by Sector of Performance.

Indicator	1999	2000	2001	2002
GERD (Gross Domestic Expenditure on R&D) / GDP	0.35	0.44	0.32	0.27
BERD (Expenditure on R&D in the Business Sector) / GDP	0.04	0.03	0.02	0.01
GOVERD (Government Intramural Expenditure on R&D) / GDP	0.16	0.15	0.16	0.15
HERD (Expenditure on R&D in the Higher Education Sector) / GDP	0.14	0.27	0.13	0.11

In 2002, as in the previous years, the biggest share of GERD, namely 56.5%, was spent in the governmental sector, followed by the higher education sector with 40.9%, and the business sector with only 2.6%. Industry invests very little in R&D activities especially because of the difficult economic situation.

Table 3. Structure of GERD (Gross Domestic Expenditure on R&D) by Sectors of Performance.

	1998	1999	2000	2001	2002
Business	11.6	12.5	5.7	6.2	2.6
Government	35.7	45.7	34.1	51.5	56.5
Higher Education	52.7	41.8	60.2	42.4	40.9

In 2002, the total number of researchers in RM was 2869. Compared to 1998 it decreased by 12.4 % and compared to the previous year it decreased by 1.4%.

Table 4. Number of Researchers.

Year	1998	1999	2000	2001	2002
Total	3275	3168	3094	2909	2869
FTE	1892	1838	1786	1630	1519
FTE per 1000 Labour Force	2.3	2.3	2.2	1.9	1.8

The number of FTE researchers in 2002 was 1519 and this number decreased by 19.7% compared to 1998. The number of FTE researchers per 1000 labour force has been decreasing during the last 5 years. In 1998 this number was 2.3, and in 2002 1.8 researchers per 1000 labour force.

Table 5. Full-time Equivalence by Sectors of Performance.

	1998	1999	2000	2001	2002
Total	1892	1838	1786	1630	1519
Business	345	290	234	205	100
Government	800	828	862	734	759
Higher Education	748	720	690	691	660

Table 6. Structure of Number of Researchers by Sector of Performance.

	1998	1999	2000	2001	2002
Total	100.0	100.0	100.0	100.0	100
Business	11.0	9.7	7.8	7.0	3.5
Government	29.2	32.3	33.7	27.8	28.6
Higher Education	59.8	58.1	58.5	65.2	67.9

5. EU – Republic of Macedonia R&D Cooperation

The European policy for R&TD in the last few years was determined during meetings organised in Vienna (December 2000), Brussels (October 2001), Bonn (March 2002), Bucharest (April 2002), Sofia (September 2002), and Dubrovnik (November 2002).

The imperative in all conclusions from those meetings was the establishment of a European Research Area (ERA) using 3% of GDP in R&D, with 2% from the Business sector and 1% from the Government sector, as a main condition for further economic development.

In 2003, two very important conferences were organised in order to specify the instruments and mechanisms for support of so-called third countries or other countries, as well as Western Balkan countries.

The first was the Dubrovnik COST conference, organised in May 2003, where the European Scientific Foundation (ESF) was promoted as the implementation agency of COST in FP6. From the accepted Dubrovnik COST declaration, it is obvious that COST will "survive" as a flexible instrument for intergovernmental cooperation in the field of S&T through the networking of more than 20,000 researchers all over Europe. Macedonia has been a COST member since 2002 and has minor participation in a few COST actions.

The second was the European ministerial conference for S&T, which was held in Salonika in June 2003, and where a special action plan for R&TD cooperation between EU and SEE countries was accepted.

According to the previously mentioned EU documents accepted in Dubrovnik and Salonika, the Republic of Macedonia can expect the following in the near future:

- Assistance in renewing of amortised equipment as a main condition for competition in the field of science, through the organisation of an appropriate donor conference or using the CARDS programme;
- Keeping the principle of "bottom up" initiation and "a la carte" involvement in ongoing projects in COST actions, until the equilibration of technology in all European countries;
- External support for the evaluation of projects with national importance;
- Networking of National Contact Points (NCP) in order to start the process of benchmarking in R&TD to achieve European standards;
- Equal right for Macedonian participation in coordinating activities of COST and other European Programs;
- Improving the mobility of researchers through simplification of the procedure for getting a visa for European countries;
- Exchange of experience between policy-makers from Macedonia with European policy-makers in R&TD;
- Interconnection of research entities at the regional and European level in the powerful electronic European gigabit network (GEANT) for science, research and education;
- Aid in easier and cheaper accessing by Macedonian scientific institutions of scientific databases;
- Respecting the real economic situation in the Republic of Macedonia to determine the symbolic contribution of the country as a fee for European programmes.

These instruments will provide a substantial contribution of the Republic of Macedonia in establishing the European Research Area.

E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 10

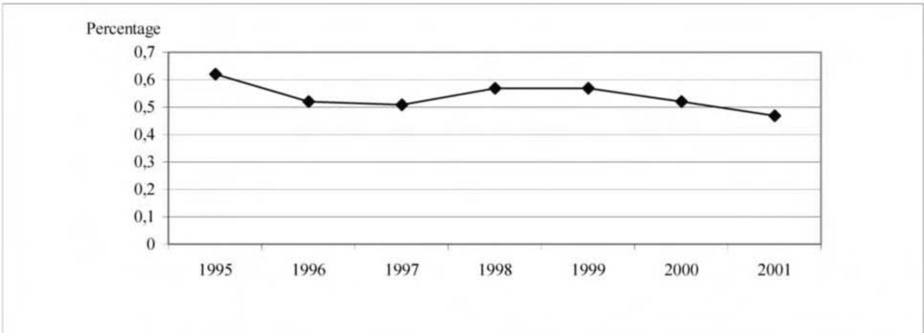
Science and Innovation Policy in Bulgaria

Dr. Milanka SLAVOVA
ARC Fund, Sofia, Bulgaria

Abstract. The main driving forces behind recent changes in science and innovation policy in Bulgaria are sustained macroeconomic stability and preparation for NATO and EU accession. Economic growth is the major challenge of the country's development. A new law promoting research was adopted in 2003. For the first time after the socio-economic changes of the 1990s, R&D was proclaimed to be a national priority. The participation of Bulgarian entities in the development of ERA and the Framework Programmes of the European Union is the most important direction of international scientific co-operation. The Ministry of the Economy has drafted a National Innovation Strategy and envisages the establishment of a National Innovation Fund supporting SMEs and start-up companies in 2005. The complex nature of research and innovation and their interaction with every economic and social activity requires a well-thought mechanism for policy co-ordination at the national and regional level. The integration of the business community and the citizens in the policy-making process should be further encouraged.

Rapid changes in science, technology development and innovation, and their impact on economic growth and the social environment, require adequate political decisions. During the transition to a market economy, the links between science, industry and society in Bulgaria had to be re-established in a new economic and social context and in an environment of increased international competition. If the "three-phase model" of science and technology system transformation in Central and Eastern Europe is used as a basis for analysis, the conclusion could be that Bulgaria has finished the second phase [1]. It is characterized by completion of restructuring, drafting of new science and innovation policy and simultaneous alignment with international developments in research, technology and innovation.

The main driving forces behind recent changes in science and innovation policy in Bulgaria are sustained macroeconomic stability and preparation for NATO and EU accession. Bulgaria is a functioning market economy. It has achieved a high degree of macroeconomic stability due to a good policy-mix brought about by the currency board arrangement, a tight fiscal stance and wage moderation. The role of the private sector is increasing through privatisation, and state aid has been reduced. There is positive development of the banking sector and some improvement in the regulatory environment [2]. Macroeconomic stability is an important prerequisite for the development of a well-co-ordinated policy approach to science and innovation in Bulgaria in compliance with the objectives and priorities of the European research and innovation policy.



Source: Social and Economic Development in Bulgaria, 2002, NSI

Figure 1. R&D Expenditure as a Percentage of GDP.

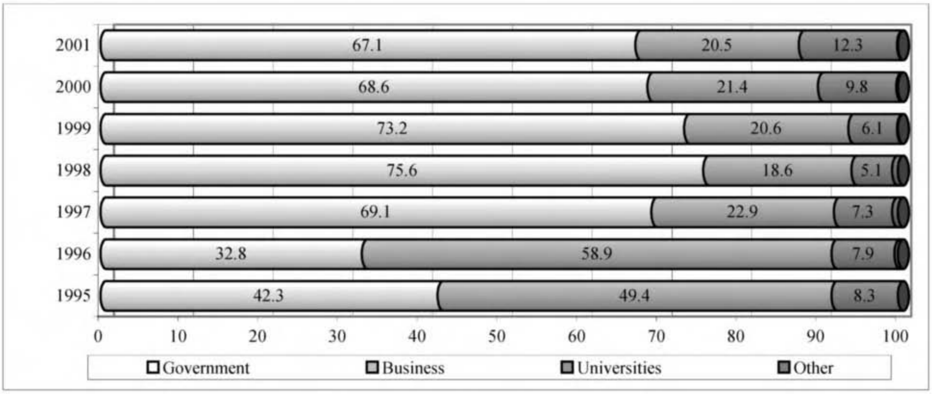
1. Current Science System and Policy

A major challenge for Bulgaria is the increase of gross domestic expenditure on R&D with a view of gradually meeting the Barcelona target. In 2001, Bulgaria adopted a national framework for the development of science and research that envisages an annual growth of 0.15% in gross expenditure on research and development as a share of GDP. However, the intensity of R&D remains low compared to EU member states and accession countries. The gross domestic expenditure on R&D as a percentage of annual GDP was 0.47% in 2001 and was decreasing (0.47% in 2000, 0.57% in 1999 and 0.59% of GDP in 1998, Fig. 1). The government sector expenditure was 67.1% in 2001 with a slightly downward trend [3]. The largest share of public funds is spent on salaries, social security for personnel and administrative costs. A positive sign in R&D funding is the decision of the Bulgarian government to increase the state subsidy for research and education for 2004 by the amount of 50 million leva (approximately 25 million euro), but it is not likely to compensate the decrease in R&D spending. Therefore, policy measures have to be elaborated in order to encourage R&D expenditure at the company level.

Basic and applied research is carried out primarily at the institutes of the Bulgarian Academy of Sciences (68 research institutes in eight science branches), the National Centre for Agrarian Science (21 research institutes), the universities and a few independent research organisations. Five Bulgarian research institutes were recognized by the EU as Centres of Excellence in different areas of competence – the Agrobioinstitute, the Nanotechnology Centre, the Centre for New and Renewable Energy Sources, the Centre for Sustainable Development and Control of the Black Sea System, and the Centre for Science, Education and Technology in the 21st Century.

In 2003, the number of researchers in Bulgaria was 21,604. Most of them (34.2%) worked in fields of the social sciences and humanities, followed by scientists in engineering and technology (22.4%) and the natural sciences (22.3%) [4]. More than 4,000 researchers are employed at the institutes of the Bulgarian Academy of Sciences [5].

An unfavourable characteristic of Bulgarian R&D potential is its age structure. By the end of 2002, more than 67% of the researchers in BAS were at the age of 45 or above. The age structure of research personnel at the universities is similar. The salaries in the research institutes and universities remain low, most of the research equipment is old, and the procedures for academic development are still clumsy, which reduces the attractiveness of science and research for young people.



Source: Social and Economic Development in Bulgaria, 2002, NSI

Figure 2. R&D Expenditures by Institutional Sector.

The de-industrialisation of the economy in the 1990s resulted in a decreased demand for R&D. During the privatisation process, many in-company development departments and industrial research and technology organisations (RTOs) were closed or downsized. In 2001, the business sector accounted for 20.5% of R&D expenditures, which is 2.5% more than in 1998 but still very low compared to EU countries (Fig. 2). The co-operative research and networking of universities, RTOs and private companies is still a challenge for science and innovation policy-making at the national and regional level.

The output indicators show that R&D in Bulgaria is a functioning system, but policy measures are needed to tackle the weaknesses in research and innovation.

- *The number of completed R&D projects is increasing*. The number of completed projects was 3,141 in 2002 and 3,161 in 2003. Most of them (55.0%) were applied research projects, followed by basic research projects (29.2%) and development projects (15.8%) (Fig. 3). A growing number of project results are commercialised in domestic and foreign markets. In 2002, for example, 29 institutes at the Bulgarian Academy of Sciences developed 182 new products. The largest share of new products was developed by the Institute of Information Technologies. The Institute of Genetics created 17 new types of tomatoes along with new types of tobacco, peppers, peas, etc. The Institute of Solid State Physics developed a new magnetic-resistant element and sold more than 20,000 units in the EU market [6].
- *Patent activity of Bulgarian individuals and companies is increasing*, though it remains lower compared to foreign companies and individuals protecting intellectual property rights in Bulgaria. For the period 2000–2002, Bulgarian applicants filed 803 applications out of 3052 and 400 patents were granted. The total number of granted patents for the period was 1282. National applicants filed 76 applications for new plant varieties and breeds and were granted 272 patents. During the period 2000–2002, the number of applications and grants for utility models and industrial design almost doubled.
- *Bulgarian RTOs and companies participate successfully in EU and other international programmes*. In 2002, the number of completed projects with international participation was 568 (almost 18.1% of all completed projects). Bulgarian scientists took part in COST actions. More than 250 projects (RTD projects, accompanying measures, research and thematic networks) have been implemented under the Fifth

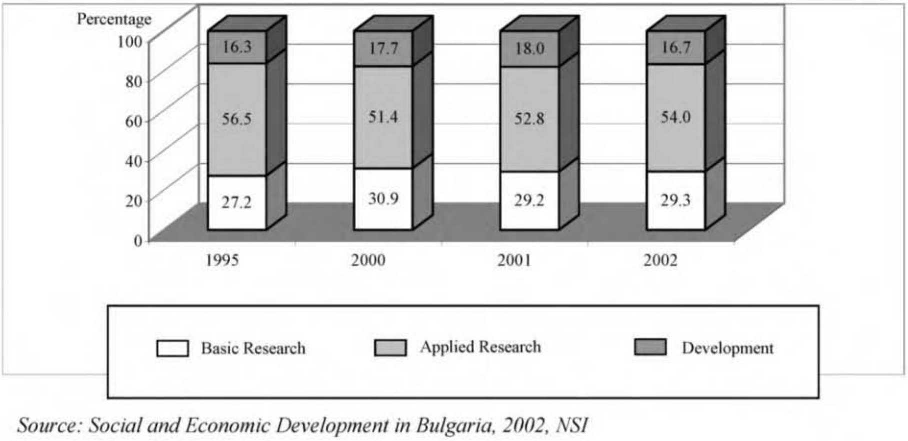


Figure 3. Completed R&D Projects by Research Type.

Framework Programme. The largest numbers of partners in projects with Bulgarian participation come from Greece and Germany, while the number of partners from other EU-associated countries is still limited. The most successful participation of Bulgarian researchers and companies is in the areas of information society, sustainable growth and human potential. Bulgarian companies have been partners in projects financed under the "Innovation and SMEs" programme. Since February 2003, Bulgaria has been fully associated with the Sixth Framework Programme for Research and Technological Development and with the Sixth EURATOM Framework Programme. The Ministry of Education and Science established a well-functioning framework of national contact points that supports participation. It is expected that Bulgarian participation will be more effective in the traditional instruments of the Programmes, due to the fact that they are familiar to Bulgarian RTOs and companies [7].

The positive changes in the national science policy during the transition period are:

- *Introduction of project financing*. Though a large part of the state R&D subsidy is still institutionally distributed, competitive application procedures for funding have been put in place. The National Science Fund (NSF) plays a major role in the introduction of the new fund-allocation principle. The NSF was established in 1990 and introduced the independent review of projects by outstanding scientists. The NSF adopted standard documents and procedures. Its internal rules and documentation are constantly being improved. A research information database has been developed and is regularly updated. Publishing activities have intensified, as have control activities on the lawful and proper spending of allocated funds. The National Science Fund extended its international contacts and became a member of the European Science Foundation in 2002.
- *Development of five national research programmes.* National research priorities are defined through the development of five national research programmes adopted by the Council of Ministries in 2001. They support the participation of Bulgarian RTOs and companies in the EU Framework Programmes. The programmes are: Genomics, Information and Communication Technologies, Nanotechnology, Space Research, and Social and Human Sciences. They are open to EU-associated countries and member states for participation, in conformity with the legislative regula-

tions of each country. Information on calls is distributed through CORDIS. Each programme contains objectives, tasks, priorities, funding sources and activities for implementation.

The aim of the Genomics research programme is to speed up the development of genomics in Bulgaria through the use of existing knowledge in this field as well as through the acquisition of new knowledge about the genomes of living organisms (bacteria, plants, animals, humans). Using the opportunities that genomics offers, efforts will be directed towards creating conditions for raising the quality of public health in Bulgaria and preserving biodiversity in the country, as well as giving Bulgarian scientific teams the chance to participate in international projects and programmes. The Genomics National Programme achieves its goals through funding integral projects in the following priority fields: genome analysis, genome basis of organism pathology, comparative genomics and genome basis of bio-variety, bio-informatics, new genome markers, and proteomics. The funding sources of the Genomics National Programme are national and international. The national sources are the state budget, NGO sector, municipalities and the industrial sector (pharmaceutical firms, agribusiness firms, biotechnology companies, etc.). The international sources are European research programmes and foreign pharmaceutical and biotechnology companies. The funding is provided using the project-competition principle for research projects whose objectives correspond to the objectives, priorities and tasks of the programme. The coordinators of the programme are the Ministry of Education and Science and the National Science Fund [8]. In the 2003competition, seven projects were financed under the Genomics Programme.

- *New R&D legislation*. In October 2003, a new law for the promotion of scientific research and development was adopted. The law stipulates the principles and tools for implementation of the government R&D policy. For the first time after the socio-economic changes of the 1990s, R&D was defined as a national priority with strategic importance for national development. The promotion of R&D envisages financial promotion, development of national research potential, intellectual property rights protection and support for the dissemination of research results. The Research Promotion Law defines the participation of Bulgarian entities in the development of ERA and the EU Framework Programmes as a priority with regard to international co-operation. The Law also stipulates the state responsibilities in the development and implementation of the science policy. An overall national research strategy is in the process of elaboration and will be adopted by the Council of Ministers six months after adoption of the Law. The strategy will define the goals of Bulgarian research activities and the appropriate tools and funds for their achievement with a view to EU membership [9].

According to the Research Promotion Law, the national R&D policy will be carried out by the Council of Ministers through the Ministry of Education and Science. A National Council on Scientific Research will be established in four months with the task of supporting the development and implementation of the science policy. It will consist of representatives from the Ministry of the Economy, the Ministry of Finance, the Ministry of Forestry and Agriculture, the universities, the Bulgarian Academy of Sciences, employers' associations, research NGOs and the chairman of the Science Fund. The variety of representatives will allow a broadening of the base for science policy development and implementation.

The Research Promotion Law establishes a Science Fund as a legal entity and defines the sources of revenue as well as the activities eligible for financing, which will be based on competitive application procedures. Under the law, additional tools for the state promotion of R&D can be implemented, such as tax incentives, low interest rates, credits and other stimuli.

Research and development activities are also stimulated through amendments to the Income Taxation Law, Corporate Income Tax Law and Rules for the Application of VAT Law, which entered into force in early 2003. Amendments have also been made to the public procurement procedures for RTOs and universities.

The major challenges of the current Bulgarian science policy are:

- To clearly define the priorities of Bulgarian science and research in order to contribute to, and participate successfully in, the European Research Area, and also to keep the traditions and achievements of the national research schools;
- To develop research potential by increasing investments in R&D at the national and industrial level and to encourage wider application of the competitive procedures for funding;
- To support and promote networking among academia (BSA, National Centre for Agrarian Science, universities, RTOs), research and industry. The co-ordination of research and innovation policy is of vital importance to the competitiveness and growth of the national economy;
- To support successful participation in EU programmes and international co-operation of Bulgarian research organisations and companies.

2. Current Innovation System and Policy

Recent studies on innovation policy in seven candidate countries comprehensively analysed the innovative capacity and policy measures in Bulgaria on the basis of four groups of factors: markets and output, human resources, knowledge-creation and investment, and transmission and application of knowledge [10]. The overall assessment, which can be applied to Bulgaria as well, is that the current innovation system is still quite fragmented and innovation policy has the important task of building and encouraging numerous interfaces between private and public agents, supply and demand, and domestic and foreign markets [11].

While many Bulgarian policy-makers are aware of the importance of innovation for national competitiveness and growth, few concrete measures have been developed and implemented to support innovative activities in the country. Until recently, the main driving forces in the national and regional debates on innovation policy were the research organisations and NGOs. They implement surveys based on OECD and EU methodology, regularly analyse the competitiveness of the country and its technological development, ensure the operation of European innovation networks in the country, attract government institutions in public-private partnerships, and elaborate recommendations for innovation policy. The reasons for lack of a government innovation policy are different. During the transition period, the government had to focus its efforts on more pressing priorities like macroeconomic stability, restructuring of the national economy and changes in social policy. Another reason is the underestimation of the role of innovation policy with regard to economic transformation and development and the insufficient capacity to formulate it. The “demand” for a national innovation policy was also low due to the above-mentioned de-industriali-zation of the economy and the limited innovative capacity of the prevailing number of Bulgarian companies.

After achieving macroeconomic stability and recognising the necessity to increase the competitiveness of the national economy, policy-makers began to focus their attention on innovation. In recent years, various institutions and organisations have elaborated national programmes related to innovation (e.g. National Strategy for the Development of High Technologies, National Programme for the Development of the Information Society, National Programme for the Development of SMEs, etc.), but their practical implementation was very limited; they are, however, a good basis for the development of a comprehensive innovation strategy.

Recent positive trends in the development of a national innovation policy in Bulgaria are the following:

- *Elaboration of innovation strategy in Bulgaria, drafts of which have been discussed in different forums*. The strategy was developed as a result of a project of the Ministry of the Economy, the Ministry of Education and Science and Dutch experts (PSO programme for bilateral co-operation between Bulgaria and the Netherlands) and is based on the teamwork of representatives from academia, business, government and NGOs. The goals of the national innovation strategy are:
  - To increase the competitiveness of the national economy through the implementation of research results and innovation, and to develop a knowledge-based economy in Bulgaria;
  - To support the country's R&D potential through the strengthening of its links with the industrial sector;
  - To develop the human potential in the field of science and technology.

The envisaged measures are in compliance with European best practice and a realistic assessment of the national resources available to implement the policy. Innovation promotion will be project based. The guiding principle of the government innovation strategy is the understanding that the promotion of innovation in the country doesn't need a new and specific legal and institutional framework but, instead, an improved innovation environment that encourages entrepreneurship and investment.

The innovation strategy draft envisages policy actions in order to increase the innovation potential of industrial companies through the development of their innovation skills and the development of a supportive infrastructure for technology transfer. The encouragement of technology transfer from the research sector to industry at the national and international level will increase the competitiveness of businesses in Bulgaria. Most of the companies are small and medium-size with a very limited capacity for new product development. Innovation initiatives of the branch association and regional authorities can also stimulate innovative co-operation and cluster formation. The attraction of foreign direct investment in research and the promotion of co-operation among Bulgarian and foreign companies and research organisations are considered to be important ways to improve the innovation potential of the country.

The innovation policy draft envisages financial and non-financial measures to promote innovation in Bulgaria. The financial measures are: promotion of innovation through the establishment of a national innovation fund to finance projects through public-private partnerships; encouragement of employment in research and development through fiscal measures; and establishment of and support to centres of competence on the basis of existing research organisations and institutes. Non-financial measures aim at optimisation of the research and development sector, assessment of the innovation potential of Bulgarian companies, promotion of academic entrepreneurship and start-up companies, the establishment of technology parks, an increase in foreign investment in R&D, and encouragement of technology transfer. The draft also defines an indicative financial framework until 2014 that will be regularly updated and adjusted [12].

- *Innovation policy measures are envisaged in the National Strategy for Encouragement of Small and Medium-Size Enterprise Development in Bulgaria 2002–2006.* Innovation and technological development support is considered a priority in the strategy. During the medium-term period 2003–2004, pilot projects for partnership among SMEs, universities, research organisations and NGOs will be elaborated in order to encourage technology transfer. SMEs will be supported financially in order to introduce quality management systems. The strategy also envisages the establishment of a supportive mechanism for technology transfer in SMEs. The long-term strategy (2004–2006) includes the introduction of financial and tax stimuli for the implementation of energy-saving technologies along with the establishment of innovation and technology transfer centres and institutions for the elaboration and implementation of innovation policy for the SME sector [13].

- *Current administrative reform in the Ministry of the Economy aims at dividing the functions and responsibilities of policy-making.* The Ministry of the Economy will develop the economic policy of the country – including the innovation policy – while the national agencies for investment and encouragement of entrepreneurship will implement it. The Bulgarian Agency for Entrepreneur Encouragement will begin operations at the beginning of 2004 and will have regional offices in the 28 districts in order to provide “one-stop shopping” services to SMEs. The new agency will combine the efforts of the current agencies for SMEs and export promotion.

A major challenge for the Bulgarian national innovation policy is the implementation of envisaged policy initiatives. Policy commitments have to be followed with budget allocations and practical schemes to address the necessary changes in the innovation system.

Another challenge is policy co-ordination. The national science policy is implemented by the Ministry of Education and Science, while the national innovation policy is carried out primarily by the Ministry of the Economy. The complex nature of innovation and its interaction with every economic and social activity requires a well-thought mechanism for policy co-ordination at the national and regional level. The integration of the business community and the citizens in the policy-making process should be further encouraged.

Policy decisions must be based on the analysis of reliable data. The science and research policy draws statistical information from surveys on research and development activity and scientists, as well as on completed R&D themes/projects, conducted by the National Statistical Institute (NSI). Internationally comparable data on all required R&D indicators and relevant levels of breakdown are compiled and annually provided to Eurostat. With regard to innovation statistics, investigative work is undertaken to develop the statistical inquiry needed for conducting a test survey of innovations in Bulgaria in compliance with Oslo Manual requirements and Eurostat recommendations on the Third Community Innovation Survey. Some of the questions included in the Community Innovation Survey were tested during the second phase of the RIS project for the South Central Region of Bulgaria. The guidelines of the NSI activities in the field of research and innovation for the period 2003–2006 envisage full compliance of the R&D statistical survey with the international methodological standard Frascati Manual and Eurostat requirements. R&D expenditure data, missing the level of breakdown by fields of science up to now, will be provided. Data on the distribution of government grants concerning R&D according to socio-economic objectives will be collected, and the requirements of the Oslo Manual and Eurostat Core Questionnaire for the Third Community Innovation Survey will be adapted to Bulgarian practice [14].

3. Implementation of New Research and Innovation Policy Instruments

The participation of Bulgarian organisations and government institutions in the EU Framework Programmes contributed to the pilot implementation of new policy tools in the field of research and innovation. The Applied Research and Communications Fund (ARC Fund), in consortium with ministries, government agencies and partners from EU member and accession countries, is piloting two new policy instruments: development of a regional innovation strategy and technology foresight in Bulgaria. Both initiatives are carried out under the Fifth Framework Programme of the EU.

- *The Regional Innovation Strategy initiative* started in October 2001. It is a joint project involving the Regional Commission for Economic and Social Cohesion of the South Central Region of Bulgaria, the Ministry of Regional Development and Public Works, Technologietransfer und Innovationsförderung Magdeburg GmbH – a company that implemented the similar "RIS-RAHM" for the land of Saxony-Anhalt in Germany, and the University of Thessaly – manager of the RIS of Thessaly in Greece.

The project is expected to produce a regional innovation strategy with a corresponding Action Plan for the South Central Region of Bulgaria. The strategy will serve as a basis for enhancing the innovative capacity of the region and will facilitate its integration with the Network of Innovating Regions in Europe, currently involving almost 120 regions across the continent. The project is in the third phase of its implementation. The consortium partners conducted surveys and focus groups, analysed innovation supply and demand in the region and elaborated SWOT analysis, which will be the basis for strategy development. The implementation of the project focuses the attention of various actors (RTOs, companies, local and regional authorities) on the innovation policy. Their participation in different activities under the project broadens the base for the formulation of a regional innovation strategy, which is one of the prerequisites for its successful implementation. The partners of the project organise information days to raise awareness on regional innovation policy issues among other Bulgarian regions and help them to participate successfully in the Sixth Framework Programme.

- *ForeTech – Technology and Innovation Foresight for Bulgaria and Romania* is a joint initiative launched in October 2002 by the ARC Fund – as project coordinator, the CRIMM Foundation of Romania (Romanian Centre for Small and Medium-Size Enterprises), the Foundation for Research and Technology – Hellas (FORTH) of Greece, University College London, Victoria University of Manchester, the Hungarian Ministry of Education, and the Czech Technology Centre AS CR.

ForeTech is a pilot initiative for Bulgaria and Romania that aims at introducing foresight activities in two candidate countries – Bulgaria and Romania – and building capacity through partnering and networking with previous and ongoing foresight activities in Europe (e.g. in Hungary, the Czech Republic, Malta, Cyprus, Estonia, the UK, Germany and Greece). The major milestone at the end of the project is a comparative analysis of the foresight programmes in the four candidate countries participating in ForeTech, namely Bulgaria, Romania, Hungary and the Czech Republic, which provides a basis for elaborating recommendations to the European Commission on science and technology policy support measures in the candidate countries.

Bulgaria and Romania are currently carrying out two pilot foresight initiatives: one in information and communication technologies and the other in biotechnology, food industry and agriculture. The focus for Bulgaria is e-government and the application of biotechnologies in agriculture and the food-and-beverage industry. In Bulgaria, national panels were set up using the nomination and co-nomination approach. Panel members were trained by international experts to apply foresight tools. The panels defined the focus of foresight by employing the STEEPV brainstorming framework. The outcomes are used as an input reference for SWOT analysis and development of a stakeholders' interest map. After the identification of driving forces (world and European developments and trends), both panels will develop scenarios. The national foresight phase will end with the elaboration of recommendations to policy-makers on the national and European level with regard to the enhancement of research, technology and innovation development. The ARC Fund has translated the template of the Practical Guide to Regional Foresight into Bulgarian in order to broadly disseminate information on foresight policy tools and their implementation in the country.

The successful implementation of both projects will enrich the national research and innovation policy with new instruments and will provide new opportunities for the Bulgarian research and business communities to participate in EU programmes.

References

[1] Meske, Werner (2002): “R&D and Innovation in Central and East European Countries – A Macrostructural View”. In: “Overcoming Barriers to Technology Transfer and Business Commercialisation in Central and Eastern Europe”, NATO Science Series, Series V: Science and Technology Policy – Vol. 36, pp. 9–21.
[2] Regular Report on Bulgaria’s Progress Towards Accession, November, 2003.
[3] “Bulgaria 2002 – Socio-Economic Development”, Statistics, NSI, 2/2003.
[4] Statisticheski spravotchnik, NSI, Sofia, 2003.
[5] Bulgarian Academy of Sciences 2002, Annual Report, Sofia, 2003.
[6] Bulgarian Academy of Sciences 2002, Annual Report, Sofia, 2003.
[7] Vutsova, A., Interview with Albena Voutsova, Scientific Research Director, Ministry of Education and Science of Bulgaria, CORDIS.
[8] National Science Fund, www.minedu.government.bg /NSF/.
[9] R&D Promotion Law, State Gazette, No 92/17.10.2003.
[10] Chobanova, Rossitsa (2003): “Innovation Policy in Seven Candidate Countries: The Challenges.” Final Report, Volume 2.1, Innovation Policy Profile Bulgaria.
[11] Radosevic, Slavo and Tomasz Miskiewicz (2003): “Innovation Capabilities in Seven Candidate Countries: An Assessment”, Vol. 2.8.
[12] Draft of the Innovation Strategy of the Republic of Bulgaria and Measures for its Implementation, 2003.
[13] National Strategy for Encouragement of Small and Medium-Size Enterprise Development in Bulgaria 2002–2006, www.asme.bg.
[14] National Programme for the Adoption of the *acquis* in the Field of Statistics, NSI, 31 January 2002.

E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 11

Current Issues of Research, Development and Innovation in Romania

Dr. Andreea VASS[1] and Dr. Steliana SANDU[2]
Institute of National Economy, Bucharest, Romania

Abstract. The aim of this chapter is to characterise the present situation of the RDI system in Romania, highlighting the way it plays a crucial role in boosting economic growth and social progress and the degree of its compatibility with the structures, overseas trends and demands of the European integration process. We focus mainly on three aspects: a current S&T system profile description, an assessment of the process of Romanian selection and implementation of RDI priorities and, finally, the key challenges for Romanian integration into the European Research Area.

Introduction

The research, development and innovation system (RDI) represents a key segment of activity, both in theory and in international practice, as an engine of social and economic progress. For Romania, the transition period has represented a major transformational step in a structural, institutional and functional perspective in association with networking with other components, so that the present configuration of the R&D system in Romania differs substantially from that of the early 1990s.

The present standing of the RDI system, with regard to Romania's primary goals of stimulating development and integration into the EU, enables highlighting the way the R&D system plays a crucial role in boosting economic growth and social progress. It also highlights its compatibility with the structures, overseas trends and demands of the European integration process. Using this approach, the present EU context must be taken into account; both the restructuring of the R&D system and the improvement of its performance through increasing productivity and reducing competitive gaps between the EU and other international competitors, especially the USA, are priority objectives on its agenda.

From the broad RDI arena, the present study focuses on three aspects that define the current features and potential of configuration:

- First, we provide a brief profile of the current S&T system, where we highlight the main institutional characteristics and the magnitude of inputs and outputs from a functional point of view.
- Second, we assess the selection and implementation of RDI priorities in Romania, aiming at highlighting the degree of compliance between:

[1] E-mail: andreea_vass@yahoo.com.
[2] E-mail: sandus@fx.ro.

- o Breakthroughs in science and technology;
- o Technical and scientific changes in the economy and society;
- o The globalisation tendencies of markets for goods and services, including the technical-scientific field.

- ➢ Third, Romanian integration into the European Research Area will be addressed. Romania is engaged in preparation for the integration process, the chapter on R&D being one of 31 negotiation chapters. Within this framework, special attention is given to the National Innovation System as a key point for economic benefit and securing the necessary premises for reducing competitive gaps between Romania and the EU countries.

1. Brief S&T Profile of Romania

1.1. Institutions

The main bodies co-ordinating S&T policy-making and innovation activities are the Romanian Ministry of Education and Research and the Romanian Academy. In spring 2003, the Ministry of National Education was reorganised as the Ministry of Education, Research and Youth, and in March 2004 it became the Ministry of Education and Research. Previously, in 2001, it also took over the responsibilities of the former National Agency for Science, Technology and Innovation (NASTI), with a view to establishing closer links between

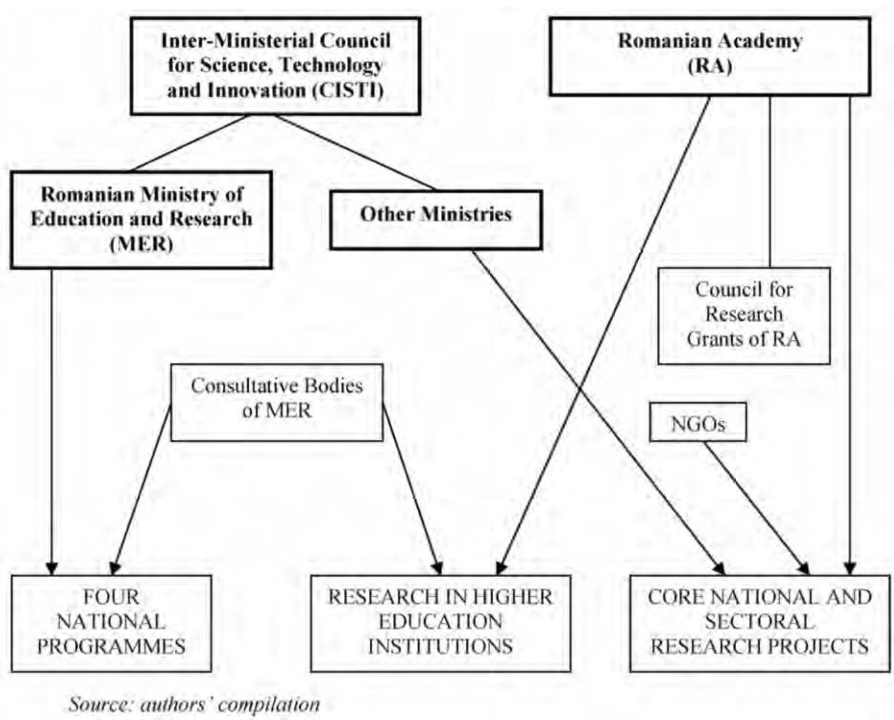


Figure 1. Institutional Linkages and Capacity for S&T Policy-Making in Romania (2004).

higher education and research.

Presently, the national programmes for research and development are co-ordinated by the Ministry of Education and Research through the Research Department, being grouped under the following main financing tools:

- The National Plan for Research and development and Innovation – including 14 RDI programmes organised by S&T fields, based on major economic and social targets (launched on an experimental scale in 1999 and updated in 2001, extending its duration until 2005). It promotes the following general objectives: increased efficiency of R&D activities in support of economic competitiveness (new products/technologies/services); collaboration in R&D projects (research & industry partnerships); promotion of S&T excellence (development of centres of excellence).
- The Grants Programmes for Scientific Research – launched in 1996 (Government Decision 735/1996), supporting the formation of scientific careers and the development of research teams around scientific personalities.
- The HORIZON 2000 Research and development Programme – operational between 1996 and 2002;

In 2003, the MER Research Department provided financial resources and will launch three new programmes for stimulating innovation activities:

- The Technological Transfer Programme – in order to establish and develop, at the national and regional level, specialised institutions of technology transfer and innovation infrastructure, in accordance with the provisions of Government Ordinance 57/2002;
- The Scientific and Technological Parks Programme – in order to establish and develop scientific and technological parks at the regional level, in accordance with the provisions of Law 50/2003 regarding the approval of Government Ordinance 14/2002.
- Core National Research Programmes, which are developed by the national R&D institutes (main public R&D institutes), reflecting the research strategy of those institutes in relation to specific sectoral development strategies.

The MER also approves sectoral research and development programmes launched in 2003, which are certified and financed by the ministries that co-ordinate the respective sectors. Their primary aim is to close the technological development gaps specific to the sector level, so that national RDI activities complement the requirements of the technological development sector/department.

The main S&T consultative bodies are the following:

- The Inter-Ministerial Council for Science, Technology and Innovation (CISTI): was reorganised in December 2001 and in August 2002, and was given the responsibility for drawing up and implementing strategies and programmes for research, development and innovation. CISTI provides correlation of R&D and innovation policies, strategies and programmes at the governmental level, providing consultation on proposals for updating the National Plan.
- Consultative bodies of the Ministry of Education and Research:
  - Advisory Board for R&D and Innovation: includes most representative personalities of the S&T community, from both institutes and universities as well as high-level representatives from the technological community in industry and services;
  - National Council for Research in Higher Education Institutions: includes representatives of the scientific community in universities;

  - Strategic Orientation Councils at the level of programmes in the National Plan for RDI, with the role to determine and update the priorities and objectives within the programmes.
  - Trilateral Commission for Social Dialogue, the institutional framework for consultation with social partners, which includes representatives from the Ministry, unions and private enterprise.

- Council for Research Grants of the Romanian Academy: Includes high-level representatives of the specialised scientific research divisions of the Academy.

The Romanian Academy conducts its own research programmes and has a network of 65 research institutes and centres, with a structure covering 14 specialised scientific divisions regarding both the technical and basic sciences and the social-humanistic field. The principal research programmes co-ordinated by the Romanian Academy include:

- National priority projects (for high-complexity scientific and cultural matters, with great impact at the national level);
- Programme of grants for scientific research (GAR – Romanian Academy Grants Programme).

The major national research programmes co-ordinated by the Romanian Academy are complex projects approaching important issues for Romania from a multidisciplinary point of view. The research institutes and centres, as well as the most competent persons in both the humanities and the exact sciences within and outside the Romanian Academy system (including the diaspora), are involved in their design. A few significant examples of projects relating to the Romanian cultural patrimony are as follows: Thesaurus Dictionary of the Romanian Language; General Dictionary of Romanian Literature; and the Romanian History Treaty. In order to evaluate Romania within the current political, social-economic and cultural context, the Romania 2020 and Information Society – Society of Knowledge projects are running within the Romanian Academy. The latter has involved more than 40 specialists (including seven members of the Romanian Academy) and ten institutes of the Romanian Academy (economic, social and legal sciences, information techniques, philosophy, psychology, and genomics). In order to develop a knowledge-based economy in Romania, the set of policy measures and actions is concentrated on the following three main objectives: stimulation of R&D investments in enterprises, attracting and training more human resources for R&D, and innovation activities.

NGOs are important players in academic research and policy design in Romania. A few examples are worth mentioning here:

- The Romanian Centre for Economic Policies (CERP) has organised, as part of a PHARE-financed project, a team of young economists advising the Office of the Prime Minister. CERP has also maintained close research-policy interaction with the Ministry of Integration, the Ministry of Finance and the National Bank of Romania.
- The Romanian Academic Society has worked with the UNDP office in Romania to issue regular Early Warning Reports under the eye of the Romanian Ministry of Foreign Affairs.
- The Centre for Policy Studies and Comparative Analysis, the Romanian Centre for Economic Modelling, the New Europe College and numerous other NGOs co-operate in numerous foreign-financed projects of policy-relevant research.

Not an NGO, but also a policy-influencing institute, is the European Institute of Romania. This is a public institution that during the period 2002–2004 completed the task of preparing, with independent experts, a collection of two series of pre-accession impact studies (dealing with the chapters on negotiations with the EU and their implications).

According to the statistics of the MER Research Department (May 2004), beyond the 19 technology transfer centres and 14 S&T parks under development (in different regions), there are approximately 600 units developing research and development activities in 2002, grouped in the following way:

- Approximately 300 RTD institutes and research centres, out of which 37 are national R&D institutes (in about 15 research fields), under the co-ordination of the central public administration;
- Fifty-six public universities (with almost 730 faculties) and 18 private universities (accredited);
- Approximately 250 joint-stock, public or private companies that have research and development as their focus of activity, of which there are 70 private limited companies and 67 companies included in the APAPS portfolio.

One of the goals of RDI institutional system development is to support the formation and development of research excellence centres in the priority fields of science and technology that may have a major economic impact and are in compliance with present international trends. Between 2001 and 2002, through the RDI National Plan, 49 research performance centres were supported from 17 research and development fields: social activities and products; architecture, construction and urbanism; computers and automated systems; chemistry; atomic and nuclear physics; electronics and telecommunications; electrotechniques; energy; food industry and bio-technologies; mechanical engineering; medicine; environment and environmental protection; materials science and metallurgy; agricultural sciences; earth sciences; space sciences; and machine-construction technologies. The CNCSIS assessment of 125 university research centres ended with the accreditation of 26 excellence centres that perform complex scientific research and technological development activities. During the period 2003–2005, the National Council for Research Accreditation will establish *7–10 additional excellence centres,* including relevant fields regarding PCVI (TIC, bio-technologies, aeronautics, new materials, micro- and nanotechnologies, health care). In 2003–2004, in accordance with the provisions of Government Ordinance 57/2002, only the certified respectively accredited units have access to public R&D funds.

1.2. Inputs: R&D Investment and Human Resources in S&T

In 2001, the gross domestic expenditure on R&D (GERD) was 0.39% of the national GDP, much lower than in the EU-25 (1.93%) or the other countries included for benchmarking (see Table 1). Due to the economic crisis at the end of the 1990s, GERD declined by 9.2% per year during the period 1997–2001. Nevertheless the share of the business sector in financing GERD (61.6%) is relatively high compared to other EU candidate countries (e.g. Bulgaria – 21.4%) and close to the EU-25 average (65.3%). Moreover, the share of business-financed R&D in the value added in industry was higher in Romania than in the EU-25 average in 2001. The overall picture of the level of commitment to the creation of new knowledge and to the exploitation of research results is unfavourable for Romania, from both a comparative and dynamic perspective. Innovation capacity, estimated with the R&D investment indicator as a proxy, declined at an average rate of 8.8% during the period 1997–2001. Industry-financed R&D declined even more in the same period – by 11.2% per annum.

According to the structure of financing, the government is a relatively more important source of funds in the national R&D system (see Table 2), but the gap between the government budget's share in GDP allocated (in 2003) in Romania and the EU-15 (in 2001) was still 0.6 percentage points (see Table 1).

Table 1. R&D Investment, 1997–2003.

	Roma-nia (A)	Bul-garia	Greece	Portu-gal	EU-25	EU-15 (B)	Gap: EU-15 and Romania (B – A)
R&D Intensity (GERD as % of GDP), 2001 (1)	**0.39**	0.47	0.67	0.77	1.93	1.98	1.59
R&D Intensity – Average Annual Real Growth Rate (%), 1997–2001 (2)	**–9.2**	–9.2	15.3	4.4	1.3	1.5	10.7
R&D Investment – Average Annual Real Growth Rate (%), 1997–2001 (3)	**–8.8**	–4.9	16.7	7.3	4.5	4.5	13.3
Government Budget Allocated to R&D (GBAORD as % of GDP), 2003 (4)	**0.17**	n/a	0.28	0.66	0.76	0.77	0.6
Government R&D Budget – Average Annual Real Growth Rate (%), 1997–2001 (5)	**–6.0**	n/a	2.1	12.3	3.2	3.2	9.2
Business Expenditure Share of R&D (BERD as % of GERD), 2001 (6)	**61.6**	21.4	28.5	40.5	65.3	65.6	4.0
Business Expenditure Share of R&D Budgets – Average Annual Real Growth Rate (%), 1997–2001 (7)	**–6.7**	3.9	5.6	12.5	0.8	0.9	7.6
Business-Financed R&D (BERD as % of VAI – Value Added of Industry), 2001 (8)	**0.24**	n/a	0.24	0.51	1.56	1.61	1.37
Industry-Financed R&D – Average Annual Growth Rate, 1997–2001 (9)	**–11.2**	3.6	23.5	22.4	1.7	5.6	16.8
Share of SMEs in Publicly Funded R&D Executed by the Business Sector (%), 2001 (10)	**48.1**	75.7	71.1	70.8	n/a	n/a	n/a
Publicly Funded R&D in the SME Sector – Average Annual Growth Rate, 1997–2001 (11)	**0.6**	–54.8	4.0	–10.4	n/a	n/a	n/a

(1) EU-15 and EU-25 do not include Malta; Greece: 1999; Portugal: 2002;
(2) EU-15 and EU-25 do not include Luxembourg and Malta; Bulgaria: 1999–2001; Greece: 1997–1999;
(3) EU-15 does not include Luxembourg and values were estimated for 2001; EU-25 does not include Luxembourg and Malta and values were estimated for 1997 and 2001; Bulgaria: 1999–2001; Greece: 1997–1999;
(4) EU-25 does not include Czech Republic, Cyprus, Hungary and Malta; EU-15 and EU-25: 2001;
(5) EU-15 does not include Luxembourg; EU-25 does not include Luxembourg, Czech Republic, Cyprus, Greece, Hungary and Malta; EU-15 and EU-25: 1997–2001;
(6) EU-15 does not include Luxembourg; EU-25 does not include Luxembourg and Malta; EU-15 and EU-25: 1997–2001; Portugal: 2002; Bulgaria: 2000; Greece: 1999;
(7) EU-15 does not include Luxembourg; EU-25 does not include Luxembourg and Malta; Portugal: 1997–2002; Bulgaria: 1999–2000; Greece: 1997–1999;
(8) EU-15 and EU-25 do not include Luxembourg, Estonia, Lithuania, Latvia, Malta; Greece: 1999; Portugal: 2002;
(9) EU-15 and EU-25 does not include Luxembourg, Lithuania and Malta; Greece: 1997–1999; Portugal: 1997–2002; Bulgaria: 1999–2001;
(10) Greece: 1999; Portugal 2002;
(11) Greece: 1997–1999; Portugal: 1997–2002; Bulgaria: 1999–2001; Romania: 2000–2001.

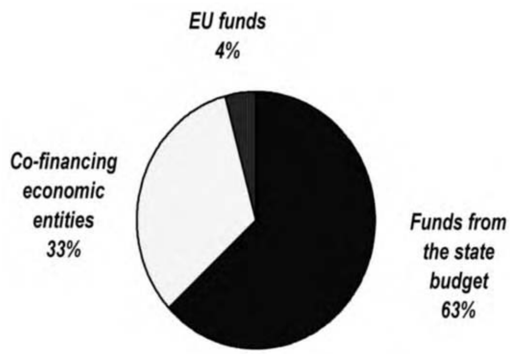
Source: EUROSTAT, European Commission DG Research – Key Figures 2003–2004

Table 2. R&D Expenditure by Main Funding Sources (%), 2001.

	Business Enterprises	Government	Other National Sources	Abroad
Romania	**47.6**	**43.0**	**1.2**	**8.2**
Bulgaria	24.4	69.2	1.1	5.3
Greece	24.2	48.7	2.5	24.7
Portugal	32.4	61.2	2.1	4.4
EU-25 (1)	55.8	34.4	2.2	7.6
EU-15 (2)	56.1	34.0	2.2	7.7

(1) EU-25 does not include Luxembourg, Malta and Lithuania;
(2) EU-15 does not include Luxembourg.

Source: EUROSTAT, European Commission DG Research – Key Figures 2003–2004



Source: National Institute of Statistics, 2002

Figure 2. Structure of RDI National Plan Financing, 2002.

The total R&D budgetary funds increased by 13% in 2002 relative to 2001 (current ROL), but its share in GDP decreased to 0.22%, and to 0.18% in 2003, according to National Institute of Statistics estimates. In 2002, the MER provided the highest share of budgetary funds for research (70%), the Romanian Academy provided 18% and the other ministries about 10%.

Actually, R&D National Plan funding comes from three main sources (*see Fig. 2*):

- The state budget (the Ministry of Education and Research, the Romanian Academy and other ministries);
- Economic unit co-financing;
- EU funding.

The budgetary projection proposed by the MER Research Department for the 2004 state budget, including multi-annual planning, provides a gradual increase in the funds allocated from the state budget for research purposes amounting to 0.32% of GDP in 2004 and 0.47% of GDP in 2005. This increase aims at fulfilment of the obligations assumed in the negotiations of Chapter 17: "Science and Research", which stipulates that Romania's public expenditures incurred by research activity should amount to 1% of GDP in 2007 and that Romania gradually complies with the European Union strategic target according to which Romanian research expenditures should amount to 3% of GDP until the year 2010.

A key determinant of the future competitiveness of the Romanian economy is the level and intensity of private R&D expenditures. The business sector in Romania spends less

Table 3. Venture Capital Investments, 2001–2002.

	Romania	Greece	Portugal	EU-25	EU-15
Venture Capital Investments – Total, 2002 (in millions of €)	**8.329**	45.384	61.565	9,212.560	9,106.929
➢ Seed	0.000	1.301	0.013	292.647	292.430
➢ Start-up	2.443	11.658	10.248	2,325.375	2,312.154
➢ Expansion	5.885	32.425	51.304	6,594.538	6,502.346
Relative Change (%), 2001–2002	**–51.3**	–50.4	–15.7	–55.7	–21.7
➢ Seed	0.0	37.4	85.7	–134.0	–41.5
➢ Start-up	54.6	–61.8	–35.9	–105.7	–33.7
➢ Expansion	–62.1	–45.9	–10.1	–31.0	–14.9
Early-Stage Venture Capital Investments per million GDP (%), 2002	**51**	92	79	275	285
Early-Stage Venture Capital Investments – Average Annual Real Growth (%), 2000–2002	**26.5**	15.5	–44.8	–38.2	–37.8

Seed + Start-up = Early-Stage.
EU-15 does not include Luxembourg; EU-25 does not include Luxembourg, Czech Rep., Estonia, Lithuania, Latvia and Malta.

Source: EUROSTAT, European Commission DG Research – Key Figures, 2003–2004

than 0.25% of its value added on R&D, this being seven times lower than the EU-15 average. The business sector, in relative terms, was not catching up with the EU during the period 1997–2001 (see Table 1), despite its high share in national R&D expenditure during this period.

Larger gaps in venture capital investments are ever present in Romania relative to the EU: 5.5 times lower early-stage venture capital as a percentage of GDP in 2002 (see Table 3). Despite the fact that a very high number of start-ups were created, early-stage venture capital was only half that allocated for expansion in 2002. The relatively high importance of the expansion phase is a common feature of all EU member and accession countries. Actually, venture capital investments are oriented towards high-tech and knowledge-intensive sectors with very-high-risk new companies. An important issue in Romania, and the accession countries as well, is that exit markets for venture capital investments are not yet well developed. The crisis of the new economy is negatively influencing investments in venture capital, as can be seen in the very strong decline between 2001 and 2002.

Total R&D full-time equivalent (FTE) personnel in Romania was 19,726 people in 2001, which represented 1.71 per 1000 labour force. This represents the lowest share of researchers in the labour force of all EU member and accession countries, with the exception of Cyprus. The share of researchers employed in the business sector is relatively high in Romania: with 57.2% of researchers employed there, Romania has the highest proportion among the EU candidate countries and a higher proportion than in some of the current EU member states (see Table 4). Human resources in S&T provide the capacity to produce scientific and technological knowledge. In Romania, the capacity to produce and absorb knowledge is highest in the business sector, which is a promising indicator of the potential future development of the production of knowledge. In terms of gender balance, Romania performs better than the EU-15 (27.2%) average with 42.8% of its (FTE) researchers being female.

The distribution of researchers by fields (see Fig. 3) indicates the clear dominance of the engineering sciences, with a slight tendency of decrease during the period 2000–2001 (from 62.4% to 59.3%). The medical, social and agricultural sciences shares increased during the same period.

Nevertheless, there is significant potential and distribution of human resources in Romania (see Table 4) if proper measures are taken and sufficient resources invested. Accord-

Table 4. Human Resources in S&T in Romania, 1996–2001.

	Romania	Bulgaria	Greece	Portugal	EU-25 (3)	EU-15 (3)
Total Number of Researchers, 2001 (FTE) (1)	**19,726**	9,217	14,748	17,584	1,084,726	972,448
By Sector (%):						
➢ Business Enterprises (%)	**57.2**	n/a	15.2	15.5	47.3	49.7
➢ Government (%)	**28.4**	n/a	13.6	21.0	14.5	13.4
➢ Higher Education (%)	**14.4**	n/a	71.0	50.3	36.0	34.5
Average Annual Growth Rate (%) of Researchers (FTE), 1996–2001 (2)	**–8.23**	–8.98	11.03	6.55	3.68	3.90
Number of Researchers (FTE) per 1000 Labour Force, 2001 (4)	**1.71**	2.68	3.30	3.51	n.a.	5.58
Number of Researchers (FTE) per 1000 Labour Force – Average Annual Growth Rate (%), 1996–2001 (5)	**–8.2**	–3.0	13.3	4.9	n.a.	2.6
Female Researchers as % of all Researchers (in HC), 2001 (6)	**42.8**	45.5	40.9	46.6	n.a.	27.2
R&D Expenditures per Researcher (FTE) (in thousands of €), 2001 (7)	**9**	8	54	58	156	171
By Sector (in thousands of €):						
➢ Business Enterprises	**10**	13	101	121	214	225
➢ Government	**9**	8	86	59	147	170
➢ Higher Education	**7**	4	38	41	90	103

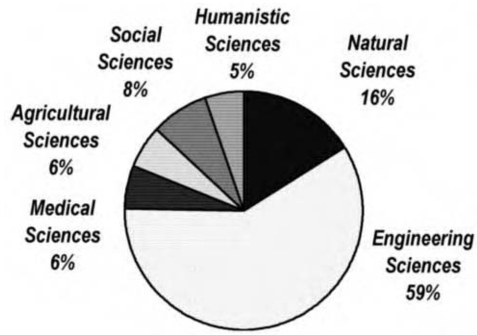
FTE = full-time equivalent researchers.
(1) Greece: 1999; EU-15 and EU-25: 2000;
(2) Greece: 1995–1999; EU-15 and EU-25: 1996–2000;
(3) EU-15 and EU-25 do not include Luxembourg and Malta. In % by sector, EU-25 does not include Luxembourg, Cyprus, Estonia, Lithuania, Latvia and Malta;
(4) Portugal: 2002; Greece: 1999;
(5) Portugal: 1996–2002; Greece: 1997–1999; Bulgaria: 2000–2001; Romania: 1997–2001;
(6) Portugal and Greece: 1999;
(7) EU-15 and EU-25: 2000; Greece: 1999.

Source: EUROSTAT, European Commission DG Research – Key Figures, 2003–2004

ing to the *European Trend Chart on Innovation 2002*, the relative weaknesses of Romania are in the fields of current lifelong learning, public expenditure on R&D, and patent applications at the European Patent Office. On the other hand, its major strengths in innovation are in the trend for lifelong learning.

1.3. Outputs: S&T and Economic Performance for the Knowledge-Based Economy

The significant disparities in R&D system inputs are reflected in the output gaps between Romania and the EU (see Table 5) and in the macroeconomic dynamics as well (see Fig. 4). In the field of S&T and performance in the knowledge-based economy, Romania is behind the current EU-15 level (as were all of the accession and candidate countries in 2001) and behind the average of the EU accession and candidate countries. This was especially pronounced for technological performance (patents) relative to the scientific performance or overall productivity, where the picture is less negative (see Table 5). Romania is doing well



Source: National Institute of Statistics, 2002

Figure 3. Researcher Distribution by Specialised Field, 2001.

in closing the gap in the number of publications and in the world market share of exports of high-tech products. Low gaps are also recorded in employment in high-tech and medium high-tech industries as a percentage of total employment (5% for Romania relative to 6.2% in the EU-15 in 2001).

In terms of growth in overall S&T performance during the period 2000–2001, Romania (5%) is a member of the group that is catching up with the EU-25 average (along with Lithuania – 13%; Latvia, Hungary, the Czech Republic and Malta – almost 6%; and to a lesser extent Poland – 3%), in contrast with the group that has a lower growth rate than the EU-25 average (Bulgaria, Turkey, Cyprus, Estonia and to a lesser extent Slovakia and Slovenia). However, the performance level was still lower in 2001 than in all of the other accession and candidate countries except Turkey and Bulgaria (which are very close to Romania).[3]

2. Science and Innovation Policy and Strategy Assessment: Focus on Priority Setting and Implementation

The identification and selection of priorities in R&D constitute an especially complex process, which requires the existence of some dedicated institutions and following some procedures validated by international practice. Taking into consideration these premises is a key issue for Romania, whose economic and social systems are experiencing a period of many difficulties and uncertainties.

Despite the diversity of the decision-making mechanisms of different countries, a series of criteria and common features of the process of selecting scientific priorities can be identified as follows:

- The interaction between the purposes of the scientific and technological community and those of political factors;
- The impact of the greater balance of science and technology cycles, compared to those from administration and politics, on the time period for making priorities, for the financing method for implementing them, and for training research personnel, requiring a long-term vision;

[3] The composite index of performance in the transition to a knowledge-based economy takes into account four most important elements: overall labour productivity, scientific and technological performance, usage of the information infrastructure, and effectiveness of the education system (EC DG Research, 2004).

Table 5. S&T and Economic Performance, 1995–2002.

	Romania (A)	Bulgaria	Greece	Portugal	EU-25	EU-15 (B)	Gap: EU-15 and Romania (B – A)
Scientific Performance [(1)]**:**							
➢ Number of Publications per million Population, 2002	**84**	182	458	339	n/a	673	589
➢ Growth Rate of Publications (%), 1995–2002	**4.9**	–1.6	7.8	12.7	n/a	2.1	–2.8
Technological Performance:							
➢ Shares EPO (Patent Applications), 2000	**0.01**	0.01	0.04	0.03	47.06	46.79	46.78
➢ Shares USPTO (Granted Patents), 2002	**0.00**	0.00	0.01	0.01	16.26	16.17	16.17
➢ Patent Applications at the European Patent Office per million Population, 2000	**0.3**	1.0	2.9	4.2	107.7	128.4	128.1
➢ Patent Applications at the US Patent Office per million Population, 2002	**0.2**	0.8	2.0	1.3	59.9	71.2	71
➢ High-Tech Exports as a % of Total Exports, 2001	**5.0**	1.6	5.5	6.8	n/a	19.8	14.8
➢ World Market Share of Exports of High-Tech Products (%), 2001 [(2)]	**0.05**	n/a	0.05	0.15	n/a	37.51	37.46
➢ World Market Share of Exports of High-Tech Products – Average Annual Growth Rate (%), 1996–2001 [(2)]	**29.01**	n/a	2.69	6.42	n/a	0.62	–28.39
➢ Technology Balance of Payments – Receipts as % of GDP, 2001 [(3)]	**0.05**	n/a	n/a	0.31	n/a	n/a	n/a
➢ Technology Balance of Payments – Average Annual Growth Rate (%), 1996–2001 [(3)]	**105.2**	n/a	n/a	7.1	n/a	n/a	n/a
Productivity Performance:							
➢ Value Added of High-Tech and Medium High-Tech Industries as % of Total Gross Value Added, 2001 [(4)]	**4.82**	4.15	1.64	4.45	8.38	8.44	3.62
➢ Employment in High-Tech and Medium High-Tech Industries as % of Total Employment, 2001 [(4)]	**5.01**	5.07	1.13	3.21	6.18	6.23	1.22

EPO – European Patent Office; USPTO – US Patent and Trademark Office

(1) Population in 2001;

(2) Includes intra-EU trade. If we exclude it, the EU-15 share drops to 20.11%;

(3) Portugal: 2002; respectively: 1997–2002;

(4) EU-25 does not include Luxembourg; Bulgaria and Romania: 2000.

Source: EUROSTAT, European Commission DG Research – Key Figures, 2003–2004

- The existence of special dedicated institutions for setting R&D priorities, generally known as "councils of research" or "national committees for science and technology", as non-political organisations, based on teams of objective experts who also make decisions regarding the allocation targets of R&D funds;

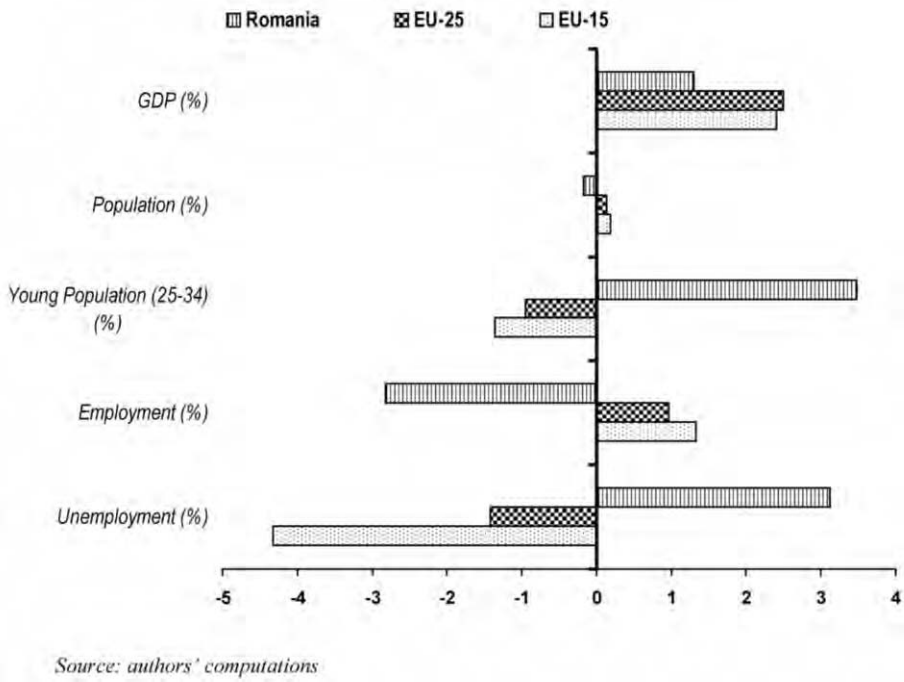


Figure 4. Macroeconomic Performance Dynamics: Romania vs. EU (Average Annual Growth Rates, 1997–2002).

- There is periodical evaluation of the priority-setting system taking into account the fact that the most steady priorities are in wider scientific fields and fundamental research compared to technological research;
- In the advanced S&T countries, there are advisory systems as general mechanisms for setting R&D priorities, where scientists, together with firms, the government, union representatives and experts in different fields participate, and the consulting procedures are flexible, in order to rapidly adjust to changes in the social and economic environment;
- Users of R&D outputs play a key role in setting priorities, especially for applicable research;
- Priorities once settled are invoked in long-term programmes or strategic plans and are correlated with the political, social and economic frameworks on the one hand and with state-of-the-art science and technology on the other.

In the successful implementation of priorities, international practice, especially European, reveals a series of key features that this process depends upon:

- Taking into consideration, to a greater extent, the strategic role of science and technology in tackling some pressing social and economic issues, such as environmental protection and sustainable development, within the frame of increasing tension between available resources and the needs of operational actors for R&D activity;
- The strengthening of the relationships between science, technology, economics and society in accordance with the increasing cost of research and innovation, the increasing speed of scientific and technological breakthroughs, and the growing need for fast data and technology transfer from research to the economy and society;

- The powerful sway of political and regional factors over the S&T system;
- The international framework has a powerful influence on selecting and implementing priorities in S&T following the increasing globalisation process to which the R&D itself contributes.

2.1. Stages in the Process of Selecting Priorities for the R&D System after 1990

Since 1990, the selection of priorities has been influenced by the new and changing economic, social and political framework. Due to the specific transition conditions, it can be stated that, until the late 1990s, the matter of priorities was not a major concern of the political actors in Romania. We can distinguish four stages of R&D system transformations that influenced the priority-setting system to a great extent.

From 1990 to 1992, the lack of demand for applicable research and of funding resources created a state of confusion, leading to the changing of most of the technological research institutes into commercial companies; the Romanian Academy's research was reorganised on the basis of budget allowances, leading to greater security and steadiness. During this period, issues of economic priority, and even more those issues in science, were not a concern for the policy-makers.

From 1992 to 1994, a structural priority was set of preserving technological research resources and potential, and, accordingly, the Ministry of Research and Technology (MRT) was created at the end of 1992, more as a consequence of the pressures from the scientific community in industrial research and less as an effect of the awareness among policy-makers of the role of this field in reviving economic growth. For implementing this priority, the Special Fund for R&D was designed, financed by a 1% contribution of the turnover of public, and later private, business enterprises. Without the direct interest of firms in supporting R&D, this system had drawbacks and operated for a relatively short time. During this period, thematic and structural priorities were not selected, but a large number of funding requests for wide thematic areas of research were financed (every year over 4000 projects were financed, most of them without any direct connection to the needs of economic agents).

Starting from 1994 to 1995, the process of selecting priorities in R&D came to be stated. The National R&D Programme "Horizon 2000" was built and operated based on priorities-selection principles. The programme was launched with the purpose of "fund allocation on priority objectives and programmes, having an inter-disciplinary and inter-sectoral approach to promote partnerships for managing complex issues". It was initially managed by the Ministry of Research and Technology (MRT), later by the National Agency for Science Technology and Innovation (NASTI), and finally by the Ministry of Education and Research (MER).

A step forward in designing priorities in accordance with the major objectives of economic and social development was made in 1999, when the national priority programmes RELANSIN, CALIST, INFRAS and CORINT were launched as a part of the RDI National Plan.

Through these programmes, the following structural priorities of R&D were set:

- Increasing the impact of R&D activities on the economy and society, following the view of economic revival and sustainable development;
- Expediting and intensifying the innovation processes and their transformation into direct support to increasing the quality and competitiveness of products and services offered by Romanian companies in domestic and international markets;
- Concentrating competencies and resources in science and technology with the purpose of extending the national heritage of science, technology and innovation;
- Complying with the legislative and institutional systems and proceedings of the EU, to a rapid and efficient implementation of the partnership for accession.

The intentions these objectives expressed were somewhat too general, without being applied in target sub-programmes, which led to accepting offers over a wide thematic range and consequently to non-strategically spending the country's R&D resources.

The National R&D Plan was updated from 2001 to 2005, through launching in September 2001 of other priority programmes (see Box 1): AGRAL, MENER, ANTRANS, BIOTECH, MANNANTECH, AEROSPATIAL and CERES. According to the perceptions of the European Commission in its Country Report in 2001: "The New Plan shifted from actions focused on offers to those focused on demand, to better answer the needs of the economy and society. Co-operation with companies was given a solid basis" (The EU Commission: 2001 Regular Report on Romanian Progress towards Accession, Brussels 13/11/2001, pp. 71–72).

These favourable trends were still insufficient for actually meeting R&D priorities and for their efficient implementation. According to European Commission statements in the same evaluation report, "The National Plan was only partially implemented, due to lack of funds. The funding of R&D activities in Romania is very low (0.41% from GDP in 1999) compared to many European countries, falling much under the European average (1.92% in 1999)". In order to be aware of the scale of the under-financing of R&D in Romania, we must add that this percentage applies to Romanian GDP, which is ten times lower than in the advanced European countries. In the latter, the R&D share has already reached 3% in some countries. In the meantime, this share continued to decrease in Romania until 2003 (see the previous section), but projections are much more positive for 2004–2005.

Box 1. Romanian Development Objectives: Priority National Programmes, 2001–2005

I. Consolidating the new knowledge-based economy:
- Information society (INFOSOC);
- Bio-technologies (BIOTECH);
- New materials, micro- and nanotechnologies (MANNANTECH);
- Space and aeronautics technologies (AEROSPATIAL).

II. Modernization of the traditional economic sectors:
- Agriculture and food (AGRAL);
- Life and health (VIASAN);
- Environment, energy and resources (MENER);
- Planning, infrastructure and transportation (AMTRANS);
- Stimulation of the application of inventions (INVENT), oriented towards the achievement of new products and technologies and based on patents owned by Romanian inventors;
- Economic revival through research and innovation (RELANSIN), targeting the modernization of the products, technologies and services supplied/used by economic units;
- Quality and standardisation (CALIST), supporting the quality of Romanian products and the upgrading of technologies, partly in order to facilitate access to the EU Single Market;
- Consolidation of the quality infrastructures (INFRAS), supporting the development of quality infrastructures in accordance with EU principles and practices.

III. Support of the general advancement of scientific and technological knowledge and cultural promotion, targeted to basic and socio-economic research:
- Programme for fundamental research of social, economic and cultural interest (CERES).

IV. International S&T cooperation and partnership:
- Programme for international cooperation and partnership (CORINT);
- Programme for fundamental research of social, economic and cultural interest (CERES).

Source: National Plan for R&D and Innovation in 2001–2005

The difficulties the R&D field has to meet due to under-financing, as well as the assessment of the European Commission concerning the "*efforts that must be made for ensur-*

ing a proper level of financing the R&D sector", must keep the decision-makers responsible for allocating public funds and finding new financing resources and incentives for the expenditure on R&D to reach at least 1% of GDP in 2007.

2.2. The National R&D "2000 Horizon" Programme[4]

The National R&D "2000 Horizon" Programme – an important stage of setting and implementing priorities – was designed to combine the structural and thematic priorities for economic and social development, according to the following criteria:

- Alignment with the priority areas for economic and social development, in conformity with the sectoral and national government strategies and with the thematic criteria of the Fourth EU Framework Programme;
- Dealing with inter-disciplinary research areas;
- Preservation of R&D capacity;
- Sustaining R&D programmes through support actions.

From a structural perspective, this programme aims at the following objectives:

- Building an efficient and secure infrastructure;
- Increasing industrial competitiveness and integrating technology and industry into European standards and regulations;
- Environmental protection and quality;
- Increasing the degree of Romania's participation in international scientific and technical activities.

The selected thematic directions, starting with the provisions of the government strategies and in the view of the Fourth EU Framework Programme, were the following:

- Infrastructure, communication and information technology networks;
    - Making infrastructure networks compatible with European and world standards and tendencies;
    - Dealing with components of the future information society;
- Energy and resources;
    - Discovering new sources and technologies;
    - National capitalisation of natural resources;
- Food and agriculture;
    - Better capitalisation of agricultural, woodland and aquatic natural resources to ensure the food security of the population;
- Environment and environmental and monitoring technologies, the Black Sea;
    - Environmental protection and monitoring methods and techniques
- Health and bio-technologies.
    - Improvement of public health;
    - New diagnostic techniques and methods;
    - Treatment and prevention.

The "2000 Horizon" Programme started in 1996 and was designed to end in 2002. It was launched through an open competition system, allowing all public and private, as well

[4] The "2000 Horizon" Programme was constructed from 1994 to 1995 and adopted through Government Decision No.1095/1995 as a national R&D programme compatible with the Fourth EU Framework Programme.

as university, academic and industrial units, to access the research programmes elaborated and co-ordinated by the 22 R&D commissions. The financing of this programme was obtained from the state budget, through the responsible governmental authority (MCT, NASTI, MEC).

Regarding the selection of thematic priorities, it could be appreciated that there was certain concern at the public authorities' level, which created 22 commissions to direct the R&D activity on priority areas. However, due to a series of drawbacks and opposing patterns (the disappearance of some research institutes and the appearance of others, the obvious tendency of researchers to migrate to other better-paid fields or to other countries) or to the way of working of consultative commissions for research functioning, in practice several divergences were identified in priority selection from the perspective of the National Programme provisions.

Among the factors which contributed to the "non-priority" funds allocation, the following can be mentioned: the expert commissions where the thematic offers were selected for financing included representatives of the main funding beneficiaries; the evaluation process did not fully respect, in practice, the scientific merit criteria established by the evaluation procedures and met difficulties in dealing with the sometimes subjective evaluators; the small numbers of evaluators relative to the wide choice of offers and extreme thematic variety; the restrictions enforced by the Ministry of Finance in the allocation of funds to different destinations; and the granting of only a small amount of the needed funds for most of the projects, therefore under-financing them. In fact, in the opinion of one of the NASTI presidents, the "2000 Horizon" National Programme aimed at financing "all that Romanian science could offer". For instance, in 1998, there were 8286 themes, operational programmes, and zoning and various subject programmes financed and carried out in hundreds of national institutes, the Romanian Academy, higher education units, non-governmental organisations and public and private commercial companies; this led to a multiplication of thematic priorities that limited financing to extremely reduced shares compared to the need for quality research.

Data analysis from 1997 to 1999 referring to the "2000 Horizon" Programme, the main instrument of promoting R&D policy in Romania at the time, allows evaluation of the establishment and implementation of priorities through funds allocation towards scientific commissions (structural priorities) and towards thematic directions as well.

The allocation of funds within this programme towards scientific commissions chiefly reveals a phenomenon of inertia about scientific concerns inherited from the former period and, on a different scale, a similar industrial and economic structure and R&D. Thus, from 1997 to 1999, with a background of substantial cutbacks in allocated funds on commissions within the "2000 Horizon" Programme, the expenditure structure actually remained the same. The highest percentage of funds was allocated to financing projects from the following fields: mechanical engineering (Commission 4); agriculture, food and wood industry (Commission 12); electro-technical, electronics and mechanics (Commission 6); physics and mathematics (Commission 15); and chemistry (Commission 7). In 1999, the projects financed within the five above-mentioned commissions represented almost 60% of the total funds allocated to this programme.

Analysis of priorities within the Scientific Commissions that absorbed most of the funds during the period 1997–1999 allows the observation that the priorities in applied research fields, relevant to economic fields, were too general in character, without a channelling of funds to real priority fields for the development stages being undertaken in Romania during this time.

The high degree of generality of the "thematic priorities" is revealed by the great similarity between their formulation and the name of the commissions and even by defining programmes established within each thematic direction. On the other hand, over the three years of data analysed here, the thematic structure of funds remained almost unchanged. In other words:

- 37% of the total funds were given to projects on industrial products and technologies;
- 14% on agriculture, wood and food industry;
- 13% on basic sciences;
- 5% on town planning, construction and construction materials.

As regards the competition of projects developed within the National Plan, there were 3,193 R&D proposals submitted in 2001, of which 1,045 (approximately 33.3% of the submitted offers) were financed. The number of proposals increased in 2002 to 3,508, but the number of projects selected for financing decreased by 60%, to 422 (about 12% of the submitted offers).

2.3. The Relationship Between R&D Priorities and Social and Economic Development

The slow progress of the selection of priorities in R&D in Romania has been determined by many factors generated by inertia regarding legacy models and by the meanders and risks of the evolution of the whole economic, social and political transition process. Furthermore, the priority selection mechanism was influenced by a series of elements specific to the R&D system, under pressure after 1990 to search for new paths. In the absence of a new strategy for selecting viable priority fields, the industrial research system went bankrupt through its inability to be financially self-sustaining, following the cutting of funds from 1990 and the breaking of links with the economic system in an uncertain context. Worthy teams of researchers, trained over decades in Romania, fell apart after 1990; some of them emigrated and established themselves as researchers abroad and others migrated to fields of activity capable of providing a decent living. However, even now, a market for industrial research has not been built and the demand for this activity is still moderate, which has led to "priorities" being defined mostly from the supply side, with policy-makers not giving enough signals related to the long-term economic development strategy. As a result, given the present situation and especially the perspectives of the Romanian economy, the priorities for R&D activities could be better defined in the light of worldwide tendencies in science and technology.

This lack of compatibility between the evolution of the R&D and industrial systems in the country is largely due to the effects of the economic transition period, when a large majority of producers are operating as subcontractors and, respectively, in assembly regimes. This distortion is even more revealed by comparative analysis of the structure of allocated research funds for the main branches of manufacturing and of the importance of the branches of industrial production in overall exports. It is noticeable that "priorities" in the allocation of funds for R&D didn't match with the tendencies of the present situation of Romanian industry and instead correlated with the research potential (number of researchers) existing in those areas. Thus, in branches making an important contribution to industrial production and exports, reduced research activity was registered, for example in textiles or leather footwear. The fields absorbing most of the research funds instead, like metal construction, machinery and equipment, contribute only 8.8% to industrial production and 8.3% to exports. The latter activities, together with a few others such as chemistry and metallurgy, absorb 90% of the expenditures on R&D (allocated to the processing industry sector), while having only 28.7% of total production and 23.4% of exports.

In this context, the question arises of defining the priorities for Romanian industry for the next period, and whether they will be those of the first 14 years of transition or other new basic priorities both in industry and in research and development.

Table 6. Distribution of Projects Submitted to the National RDI Programmes for Financing in 2002.

NPRDI Programmes	Total Projects 2002
1. AGRAL	149
2. VIASAN	135
3. AMTRANS	61
4. MENER	179
5. INVENT	72
6. RELANSIN	1,521
7. CALIST	314
8. INFRAS	142
9. INFOSOC	95
10. BIOTECH	132
11. MATNANTECH	118
12. AEROSPATIAL	28
13. CERES	271
14. CORINT	69
TOTAL	**3,286**

Source: MER, Presentation of Romanian RDI System and Performance, May 2003

Establishing priorities in R&D is at an intermediary stage, taking into account that this problem was seriously raised only after 1999 within the context of valuable approaches to European integration. The issue of setting priorities, although extremely important and pressing, under the conditions of serious cuts in R&D expenditure in GDP over the last 5 years, is tackled in a more realistic way at present, while trying to overcome formalities, build institutions and mechanisms and provide more resources for implementing selected priorities. Extreme thematic and institutional losses and the shortage of users of research outputs still constitute a barrier blocking the setting of priorities on key scientific, technical, social and economic fields of interest. Building on these, confusion has existed over a long period of time regarding the restructuring directions of the main branches of the economy. However, they were stressed and addressed in the national RDI medium- and long-term plans.

Through the project of the new Law on Scientific Research and Technological Development, there appeared a series of favourable premises through setting up a National Council for Science and Technology Policy, having as its role that of setting viable priorities within the National R&D Strategy. There were also initiatives set for building consultative committees for Research, Development and Innovation, having a large representation of the scientific community, ministries and relevant economic agents (see the previous section for details).

During the 2002 contests, a bidding process for 107 R&D priority projects was organized, the first since the launching of the RDI National Plan, and they were applied for by the economic ministries to support the development targets proposed by the sector strategies of the respective fields. From the almost 3300 projects submitted for financing in 2002, distributed as shown in Table 6, 451 projects were finalized, thus allowing the respective resultant transfer to the economy, most of them representing new or improved products or technologies in the economic environment.

2.4. Policy Measures to Promote More Efficient S&T Application in 2002–2004

Two main areas are concerned in this respect:

I. Measures to promote R&D and innovation in enterprises: in order to increase the impact and efficiency of R&D activities in support of economic competitiveness, the following two policy lines are pursued:

- Revival of traditional industrial sectors through technological modernisation: alignment of products, technologies and services to the quality and competitiveness requirements specific to European and international markets; alignment of enterprises to the operational requirements imposed by European and international standards; introduction of new technologies in traditional sectors;
- Development of high technology sectors: formation and development of internal sources of scientific competence and technical expertise in these fields; stimulation of R&D investment of high-potential firms in the respective fields.

The structure and objectives established for the programmes of the National Plan for R&D and Innovation respond to these policy lines in a clear manner. The Plan, through its eligibility conditions as well as evaluation criteria, especially promotes those R&D projects that:

- Support the development of new products, technologies and services achieved in industrial enterprises in partnership with R&D organizations, including institutes and universities, and which have higher chances for internal and external market penetration;
- Are based on project co-financing from both the programme budget and enterprise partners;
- Develop the "market" for R&D results, through data banks and Internet services for online processing of information on R&D supply and demand and available R&D results;
- Assure a special IPR regime and free transfer of R&D results obtained in programmes financed from public funds, to enterprises that assure the final phases of technological development and production;
- Attract young researchers;
- Are supported by international collaboration.

Due to the co-financing of collaborative R&D projects within the programmes of the National Plan for R&D and Innovation, the business sector expenditures contribution to the overall budget of the National Plan increased throughout the period 2001–2002, reaching 35% in 2002.

A special measure for promoting the creation and development of innovative SMEs is intended to be developed in the near future through the introduction of new financing tools of the risk-capital class, based on joint public and private funds. Government Ordinance 57/2002 stipulates the establishment of the Investment Society for Technological Transfer and Development as a new financing institution supporting capital infusion in greenfield and development investments, exclusively for SMEs that develop and apply new technologies.

II. Infrastructures for technology transfer and innovation: the diffusion and transfer of S&T knowledge and R&D outputs in the economic environment is a special current focus of the policy measures. A special programme for technology transfer – INFRATEH – was recently approved by Government Decision No. 128/2004. The programme is co-ordinated by the Ministry of Education and Research and will promote the development of specialised infrastructures for technology transfer and innovation, especially at the regional level, including: technical assistance and information centres, technology transfer centres and incubators, S&T parks, etc.[5]

---

[5] We mention 14 local joint initiatives of R&D institutes, universities and the public administration, which were meant to create S&T parks in the respective areas (e.g.: Cluj, Timişoara, Constanța, Bucureşti, Braşov, Craiova, Pitești, Galați, Brăila). The S&T parks initiatives are a very proficient form for stimulating the creation and development of innovative SMEs, especially due to the "spinning-off" from RTD institutes and universities.

3. Present Key Challenges: S&T Policy-Making in Romania in a European Context

3.1. R&D Priorities in Government Documents

- The National Strategy of Romanian Medium-Term Economic Development (NSRMED): 2000–2004. The issue of establishing priorities in R&D was given new significance once Romania was invited to start negotiations to join the EU. Romania's preparation for integration into the EU is a complex process aiming at the promotion of a coherent policy compatible with the EU mechanisms in R&D. In the National Strategy for Economic Development of Romania in the medium term, comprising the main objectives and policy needed for Romania to meet the main requirements for accession to the EU in 2007, policy-making in science and technology takes a special place. It contains the priority objectives of RDI referring to:
  - The development of the capacity for producing scientific and technological knowledge;
  - The increase of the R&D units' quality and efficiency through the development of specific infrastructure, improvements in management and pay, and an increase in the capacity of absorption of research outputs;
  - The development of R&D and innovation potential at the firm level through the conducting of joint projects with the institutions and expert centres and the use of co-financing incentive schemes;
  - The gradual increase of R&D and innovation expenditure shares in GDP, to levels compatible with the EU member countries.

As can be noticed, the formulation of these objectives is quite general and does not allow the revealing of specific strategic priorities in the field for the next period. During the last 3 years, a relevant improvement was induced by the process of annually updating the programme priorities of the NSRMED.

In 2002, it was mainly focused on the following issues:[6]

- Continuous increase of the RDI contribution at the completion of the government policy targets mainly within the important sectors and fields for sustainable development and the European integration process;
- Significant promotion of advanced technological results, particularly within the economic entities;
- Support for the establishment of national research networks, by fields relevant to integration within the European Research Area;
- Support for RDI activities with impact on regional development.

In the same context, in 2003, a series of priority targets was designed for each of the scientific and technological fields approached, referring particularly to:

- The method of correlation with the major development orientations within the connected economic sectors;
- The directions and targets of concrete research and technological development, which might provide competitive advantages for Romania:

[6] Under these circumstances, an important event was the National Conference of Research, organized for the first time, in April 2002. The Conference provided the scientific community with the opportunity to largely discuss the issues surrounding the structure and priorities of the national research programmes. Also, the Conference of the Ministries of Science and Research from South East European Countries was held during the same period. Both events were dedicated to the review of all the issues regarding European integration and perspectives related to participation in the RDT Framework Programme of the EU between 2002 and 2006 (PC6). A delegation of the European Commission led by the general manager of the General Research Directorate, Mr. Achilleas Mitsos, attended both events.

(i) Identification of product/technology categories and, respectively, specific products/technologies that may constitute realistic development and production targets in our country;
(ii) Identification of product/technology categories and, respectively, specific products/technologies for which development and production our country can participate as a partner within international technological programmes/alliances.

- Estimation of research and development timing, potential and infrastructure to accomplish each of the established targets;
- Solutions for developing integrated technological groups and networks (technological clusters), including those with the potential to accomplish the established targets: research and development units, universities and economic entities dealing with similar activities;
- Niche identification for cooperation and technological integration at the international level, particularly in the high-technology field;
- Correlation with the fields and targets promoted within the European Research Area, for the dynamic integration of Romania.

➢ Priorities of RDI in the Government Programme from 2001 to 2004 (The Official Monitor of Romania No. 700, 2000, Dec. 28). From the government programme, the following priorities for the RDI field can be drawn:

- The restructuring of the national system of scientific research through the defining of strategic fields and the financing of research in these areas; the diversification of funding sources; better capitalisation of research outputs and Romanian inventions;
- The adjustment of the national system of RDI to the requirements of the process of EU integration;
- The endowment and informatisation of a research unit system providing better compatibility with EU levels;
- The strengthening of networks between research and industry at the national and regional level through the development of specific institutions;
- The increasing of interest in science through a specific training and incentive system;
- The provision of a legislative framework (research laws and researcher regulations) needed for the efficient functioning and development of the national system of research, development and innovation.

In the years following the launching of this programme, there have been slight concerns to apply a series of measures aimed at meeting the targeted objectives. Thus, a package of laws to deal with the unsettled issues was forwarded to the Parliament for debate during the period 2001–2004. These concern: the Law Project of Scientific Research and Technological Development; the Law Project referring to Regulations affecting R&D Personnel; the Law Project referring to establishing the method of Approving the Budgets of Incomes and Expenses of national institutions of research and development; the Law Project for completion of Government Decision No. 25/1995 regarding the regulations for organising and financing research and development activity; the Law regarding the organisation and functioning of the Ministry of Education and Research; and the Law dealing with ethical concerns in developing technological research and innovation. The provisions of these laws constitute a favourable basis for meeting the above objectives. There has recently been increasing concern related to the capitalisation of research outputs, especially in technological terms, through implementing the industrial and scientific parks.

In this context, there are some examples of achievements that indicate the reliability of measures undertaken during the period 2001–2002, mentioned in the RDI 2001–2002 Report drafted by the Ministry of Education and Research (January 2003), such as:

- A five-fold increase in the amount of funds from the economy that went to the R&D units in 2001 compared to 2000;
- A nine-fold increase in funds from the European Union granted to the R&D units through participation in the Fifth Framework Programme of technological research and development;
- A new positive trend was inaugurated in 2001 and 2002, targeting stabilisation and increasing the number of employees in the research-development-innovation field. The younger generation (students, young researchers) has become more motivated and involved in national RDI projects. More than 2,800 new young researchers entered the doors of institutes and units that have research, development, design and innovation as their main activity. The Romanian scientific community is thus relatively protected, being ensured of the regeneration of the specialist groups;
- For the first time in the history of Romanian scientific research, the country won first place at international invention fairs in 2001 and 2002, the majority with gold medals (awards for acknowledgement at the global level).

3.2. Romanian RDI Integration into the European Research Area

By 2001, the focus on setting objectives and priorities in RDI was almost exclusively put on European integration, with the framework of participation in the construction of the European Research Area (ERA) as its main strategic direction. This concern for complying with EU directions and priorities is expected to result in the boosting of scientific research and technological development in Romania. It must be taken into account that the European RDI system itself is undergoing a new stage of restructuring to close the performance gaps relative to its main overseas competitor, the United States.

The European Research Area is a long-term strategy of the EU. In the medium term, from 2002 to 2006, the priorities were defined through the document "Making a Reality of the European Research Area", where the practical actions and instruments of the ERA that would be implemented through the Fourth to Sixth Framework Programmes were mentioned.

The Romanian standpoint regarding integration into the ERA was sustained through a series of documents reflecting the acceptance of the *acquis communautaire* regarding science and research. In these documents, a series of general priorities are recorded, for instance:

- The development of legislative, financial and organisational support for assuring participation in the EU Framework Programmes;
- The general preparation of the field for accession, and for integration into the ERA;
- The correlation of national research programmes, building networks of excellence and specific large research projects.

Romania aims at permanently meeting the needs of the national RDI within the EU, building the ERA and the priority actions needed for its creation as a similar framework. Nevertheless, the priorities of scientific research and Romanian technological development formulated in the documents regarding integration into the European Research Area involve national specifics, coming from the restructuring and re-engineering of the needs of some structural components of the R&D system and meeting the present and future needs of the country. It is worth mentioning in this respect the main general and specific targets established in accordance with the government's development strategy (see Table 7).

Table 7. Priorities Established in Accordance with Domestic Sectoral and External EU Pressures, 2003.

1.	**Sectoral Development Targets, Including Technological Modernisation**	**General Priority Targets** – Promotion of investments at the sector level; – Accomplishment of the targets specific for each sector regarding the accession process of Romania to NATO and the European Union. **Specific Targets for the Industrial Sectors** – Modernisation of industrial processes: increasing energy efficiency, performance and productivity; valorisation of primary and secondary resources; – Providing compliance of existing industrial activity with the environment; – Improvement of the quality and competitiveness of products, technologies and services provided by economic entities; – Introduction of new, efficient ecological technologies within industrial processes in accordance with sustainable economic growth requirements; – Improvement of work environment quality and safety; – Efficient and safe utilisation of nuclear power for reliable development. **Specific Targets in Agriculture** – Increasing and diversifying agricultural production; – Improvement of farm products, food quality and competitiveness; – Ecological and reliable development of agricultural activities; – Improvement of the agriculture and food industry technical endowment; – Development of the rural environment. **Specific Targets of the Health Care Sector and Environmental Protection** – Improvement of public health; – Improvement of environmental quality; – Providing the conditions for reliable economic growth: protection, rehabilitation and reasonable exploitation of nuclear potential. **Specific Targets for the Social, Cultural and Tourism Sectors** – Stimulation of the young generation's participation in economic and social life; – Recovering the values of the national cultural patrimony and considering the perspective of its international recognition; – Valorisation of tourism potential under reliable growth circumstances; – Improvement of Romanian tourism quality and competitiveness.
2.	**Actions for Takeover and Implementation of the *Acquis Communautaire***	Compliance with European Union directives; Assumption of European Union recommendations; Harmonisation of national standards with European ones; Harmonisation of non-standard methods and procedures; Harmonisation of organisational systems and procedures, planning, follow-up and reporting of economic activities at the sector and national level.
3.	**Actions for Market Opening and Stimulation**	Introduction and utilisation of free-market and competition mechanisms; Development of the domestic market; Export progress; Enhancement of access to international markets.
4.	**Actions Regarding Sector Restructuring, Including the Service Sector**	Completion of structural modifications at the sector level; Development of research-development-innovation capacity at the sector level.
5.	**Other Actions or Targets Provided by Sector Development Strategies**	Qualified personnel development within the sector.

Promoting the development of centres of excellence and ensuring some domestic professional competency and expert sources in state-of-the-art science and technology in priority economic fields is also considered a key priority for Romania. Starting with the present situation, and taking into account the future possibilities and needs in this field, the responsible actors consider that this intent is applicable through evaluation and systematic accreditation of RDI organisations, using European criteria to allow the selection of expert RDI and therefore a better allocation of public funds for R&D. To meet this objective in the Project of the Research Law, which was discussed and approved by the Parliament, there is provision for creating an institution of expert evaluation, as a key to setting priorities in expert and applicable R&D fields and for better allocation of public R&D funds. Ensuring competence and high scientific and technological expertise will be realised through the improvement of co-operation with the European countries in science and technology as well as the development of a network system to include the RDI organisations of the EU member states and candidate countries.

Yet, there remains a very serious gap between infrastructure development in Romania and that in other developed European countries. Within the context of low and decreasing investment funds over the last few years and of slight concern for improving the facilities of some institutes with state-of-the-art equipment, up-to-date research work and the building of modern, applicable partnerships to allow access of Romanian researchers to European programmes are difficult to foresee. In 1996, the capital expenditure share in total R&D expenditure was about 7.2% and in 2001, this indicator reached 11.9% (from an extremely reduced volume of R&D expenditure representing only 0.39% of GDP, even if the nominal dynamics in 2001–2002 were favourable as stated earlier). Therefore, an important objective that Romania has, with a view to approaching compatibility with EU-level proposals, is the development of the research infrastructure.

To improve its existing situation, Romania aims at: developing centres that provide facilities and work conditions at the European level; supporting the access of Romanian researchers to important EU research facilities; developing information and communication infrastructure in R&D units; creating a national network of computers for research and a rapid communication environment; and having high capacity networks to include both the RDI units of the EU member states and Romania.

The creative potential of a country in producing and using knowledge can be seen in the indicator “Share of Researchers in the Total Workforce”. Having 1.71 full-time researchers per 1000 employees, Romania is under the EU average (5.5/1000 employees) and well under some developed EU countries: Finland, Sweden, Denmark, France, Germany and Great Britain (see Table 4 for more details). Romania’s human research potential is expressed in a low number of researchers per 1000 inhabitants, approximately two-thirds lower than the European average, and recently there have been important cuts in the number of recorded researchers. Thus, in 2001, the number of recorded researchers was one-third lower than in 1995. This decrease in the number of researchers must be evaluated in connection with research personnel flows, considering the fact that many valuable young researchers have left this field for better-paid positions throughout the country or abroad. The share of young researchers under 30 years old in 2001 was only 14.3% of all researchers, 45% being between 40 and 60 years old, and 25% being older than 60.

Taking into consideration the above-mentioned facts, another priority in the Governmental Programmes of Integration into the European Research Area is the development of human resources in the scientific, technical and innovation area. With this purpose in mind, there are actions planned for the recruitment and training of young researchers following the European model of scientific careers and for the establishment and promotion of a legislative framework for researchers.

To comply with the EC objective of strengthening the innovation capacity of firms through scientific and technological research, Romania intends the following: to promote some specific national programmes; to build co-operation between R&D units and high-tech firms; to design programmes to build an information network; to provide documentation and support for SMEs oriented towards new technologies; and to increase the capacity of the R&D units to spread knowledge and research outputs as well as their experience. The stimulation of technology transfer, of demand for research services and of research output absorption in existing firms will be supported by the establishment of the National Investment Fund for Research and Development (a Risk Fund for application of R&D results).

In meeting this objective, the level of research in Romania and its relatively low capitalisation of research outputs in industrial production must be taken into consideration. From the existing statistical data, it can be stated that the share of enterprises undertaking R&D activity out of the total enterprises in the processing industry decreased from 10.1% in 1999 to 5.2% in 2001. The lowest rate of decrease can be observed in the traditional industry branches as follows: the processing of crude oil and coal, rubber and plastics, chemicals and synthetic and artificial fibres, and metallurgy.

Box 2. Success Stories: Romanian Innovations of Global Use in the IT Industry

1. Microsoft, the leading global software producer, acquired the Romanian-owned private company Ge-Cad – a firm started from scratch in the early 1990s by a group of students – in June 2003. The main product of the Romanian company was a locally developed anti-virus programme named RAV. Following this acquisition, Microsoft announced plans to use the RAV application in its products.

2. A local rival of Gecad, Softwin, also sells its software products abroad. Softwin is a private Romanian company that provides software solutions and services and is a leading provider of data security solutions and services. Founded in 1990, Softwin was the first Romanian software company set up entirely with Romanian capital to be certified ISO 9001. In 2002, Softwin's anti-virus software, BitDefender™, won first prize in a competition organized by Euro-CASE with the support and sponsorship of the European Commission's Information Society Technologies (IST) Research Programme. This was the very first time (in the history of the competition) that one of the awards went to an Eastern European company. In August 2003, RAE as Internet provider of anti-virus, anti-spam and Linux Groupware products was appointed as the US distributor of BitDefender Antivirus Solutions through a distribution agreement.

3. Another IT company of local origin, which benefits from continuous product innovation, is Flamingo – it has now become a multinational company *de facto*, with affiliates in seven EU member states and candidate countries.

Regarding the overall processing industry, the share of enterprises where new and improved products have an important share in business and exports is much reduced compared to firms that undertake R&D activities. In 1999, 2.8% of the total number of enterprises had a higher share of new and updated products than 10% of their turnover and 2% in terms of exports, but by 2001 these shares were 2.1% and 2.4% respectively. Even for enterprises in modern branches producing higher value-added goods and with strong research activity (machinery and electrical devices, radios, TVs and telecommunication equipment, medical precision instruments, optics and clock-making), there is no tight correlation between research activity and their economic performance. However, we should highlight the existence of several success stories in the IT industry (see Box 2).

At present, at the European level, there is the opinion that the key to success in research is partnership and scientific collaboration. Within this context, a condition of participation in the EU R&D Framework Programmes is, on the one hand, the building of a complex multinational team of high professional training and open to co-operation and integration into international teams, and on the other hand, the capacity and co-financing will of the governments of participating countries. Romania, which lacks sufficient resources to develop research activity at the present level of requirements, could capitalise to a greater extent on the advantages offered by collaboration with European plans within the Fifth and Sixth Framework Programmes. The capitalisation of these opportunities implies both a long-term financial effort by Romania itself and the increased capacity of Romanian research to offer expert partners along with the improvement of the quality and efficiency of participation in the European programmes.

According to the assessment of the European Commission, the financial contribution of Romania to the budget of the Fifth Framework Programme was significant for a limited-resource country. Despite the fact that Romania increasingly supports the European programmes budget, the degree of participation of Romanian researchers in the Community programmes has unfortunately not been in accordance with the national financial effort. Thus, in 2001, Romania registered the lowest participation rate of European countries applying for integration as well as a reduced number of signed contracts.

There are many factors that explain the low participation of Romania in the research activity carried out in the European programmes, among which we can mention: Romanian research isolation from the international scientific community before 1989, leading to behaviours and constraints on collaboration with expert partners from abroad; lack of domestic co-operation even between the research units in industrial scientific academies and universities; administrative, institutional and legislative malfunctions; the lack of proper infrastructure for outstanding research; etc. However, the European Commission appreciates that “the recent reorganisation of research activities at the governmental level is an important accomplishment. Nevertheless, the intensifying of co-operation between the research centres, universities and enterprises to ensure successful participation in the EU Framework Programmes is compulsory.”

The improvement of the quality and efficiency of Romanian researchers’ participation in the EU R&D programmes constitutes a concern for the responsible institutions under the circumstances of being a negotiation chapter for accession to the EU. Within this context, the government must not curb its financial contribution to the European Framework Programmes budget, but there is a need for greater concern with regard to co-financing the winning projects and ensuring their satisfactory management as well as some specific structures for their implementation (committees, consultant groups and evaluation teams).

Another condition for developing scientific and technological activity in Romania, for its compatibility with the EU and for increasing the international competitiveness of Romanian research, consists of ensuring its access to the facilities offered by the Internet and other communication and information technologies. “Access to the Internet at Home” constitutes a key evaluation indicator of the innovative capacity of a country. At the EU level, the share of households connected to Internet networks in the R&D field in 2000 was 28%. In the meantime, in high performance countries (Netherlands, Sweden, Denmark, Finland and Great Britain), this indicator was over 40%; in the USA this share is 47%.

In Romania, access to this infrastructure is limited at present, firstly because of the extremely high cost of equipment and connection to special networks compared to the decreasing incomes of potential users. Data provided by the 2001 Human Development Report indicate the cost of connecting to the Internet in the USA, for instance, represents 1.2% of the average monthly income. In our estimation, the cost of using the Internet at home in Romania was about 50% of the average net monthly salary (in March 2002).

If individual access to the internet is difficult, it must be underlined that, unfortunately, the open access of researchers to the information offered by this infrastructure cannot be provided even in the research institutes; therefore, this represents a major disability both in communicating with researchers from other countries, and consequently in finding partners to access European programmes, and for rapid acquisition of information in the field of interest as well. Within this context, we must mention that the allotted budget, beyond its extremely low level, imposes restrictions on the allocation of funds so that most of them are channelled into payment of salaries.

There are some favourable premises for alleviating the shortcomings regarding public financing as a consequence of the Romanian RDI system's integration into the ERA, as this would imply the adoption of some package of rules concerning financing from specific public European funds for RDI: minimal rates of financing from public funds for RDI; minimal rates for institutional financing from public funds ("core funding", investments); public policies for boosting investments in RDI; and the increasing role of venture capital in financing research.

Involvement of the scientific and technological community in Romania in designing the Framework projects can be improved, both through approved actions by the public authorities aiming at the development of a viable collaboration in R&D through partnership with potential participants from EU member countries, and through stimulation of a proactive attitude towards the identification and ensuring of a higher capitalisation of participation opportunities and improvement of the capacity to formulate consistent and competitive proposals.

3.3. Participation in EU and Other International Co-operation Frameworks

The targets referring to integration within the ERA are achieved by using the following tools:

- National Plan of Research, Development and Innovation (CORINT Programme);
- National Accession Plan to the EU (PNAR).

CORINT supports the participation of Romanian researchers at research programmes from the European area, including the following sub-programmes:

- EU-RO for co-financing the projects with Romanian participation from the RDI Framework Programmes;
- NUC-INT for co-financing of Romanian participation projects of the RDI Framework Programme EURATOM;
- Sub-programmes for supporting participation in other European area programmes such as COST, NATO and EUREKA, as well as sub-programmes dedicated to bilateral scientific and technical co-operation, first with the EU state members.

The funds allocated for International Co-operation and Partnership (CORINT) amounted to approximately 6% in 2001, while in 2002 this reached almost 12% of the budget allocated for the whole RDI National Plan. For 2003, the percentage allocated for CORINT is estimated to be 10%, out of which the funds allocated for participation in the sub-programmes of CORINT, which ensure participation in international programmes developed within the European area (FP 5 and 6, COST, NATO and EUREKA), represent 75% of the total budget of CORINT programme.

Romania's participation in EU research and development FP5 accounts for about 220 contracts, which involve both R&D institutions and industrial partners, and for € 200 million in total value. These contracts refer to fields such as:

- Quality-of-life (12);
- Information technologies (47);
- Competitive and sustainable growth (47);
- Energy, environment and sustainable development (43);
- International co-operation (14);
- Human potential and socio-economic research (19);

- Nuclear research – EURATOM (7).

Funds from the European Union increased approximately nine-fold between 2000 and 2002, mainly due to the financing of projects with Romanian participants accepted within the 5th RTD Framework Programme and the EURATOM Framework Programme of the European Union (1998–2000). The European contribution amounted to about 43.5 billion ROL in 2001, and 38.5 billion ROL in 2002 (current exchange rate).

The total contribution of Romania is €87.675 million for the period 2002–2006, out of which:

- Romania's contribution amounts to €14.24 million in 2003:
  - €13.2 million for FP 6;
  - €1.04 million for FP 6 EURATOM.
- Romania's contribution amounts to EUR 17.23 million in 2004:
  - €16 million for FP 6;
  - €1.23 million for FP 6 EURATOM.

To cover the contribution expenditures, 50% of the amount will be financed from the PHARE programme.

We mention two other main co-operation frameworks:

- Bilateral S&T co-operation, based on inter-governmental agreements, accounting for around 400 projects a year. More than 40% of the projects are developed in the European area, mainly with partners from Austria, Belgium, France, Germany, Greece, Hungary, Poland, Switzerland and the countries of the former Yugoslavia. Collaboration outside Europe mainly includes China, Japan, the USA and South Africa.
- Co-operation within international S&T organizations, out of which we mention: UN bodies including UN-CSTD; the International Atomic Energy Agency; CERN; UICN – Unified Institute for Nuclear Research; the European Space Agency; NASA; ECI – European Central Initiative; OBSEC – Organisation of the Black Sea Economic Co-operation; and ICGEB – International Centre for Genetic Engineering and Bio-technology.

The improvement of the quality and efficiency of Romanian participation in the EU Framework Programmes presupposes the harmonisation and political consistency of long-term science and technology policy in the European Research Area (the formulation of objectives, planning and correlation of activities and implementation) through: the intensification of dialogue with representative European organisations; the formulation of adequate action plans to apply and implement national policies; the development of an adequate participation framework in the Community programmes in accordance with the present research and development potential, at the programme and project level, through launching negotiations on time; and having in view a more realistic evaluation of the national policy and financing capacity for participating in large projects. Meeting these objectives and creating an adequate framework of participation in the EU programmes depends on ensuring proper financing of the R&D system in Romania; it is estimated that the minimum financing level allowing implementation of the above objectives is more than 1% of GDP (about €150/inhabitant or €300,000/researcher), compared to the actual figure of 0.39% in 2001.

Taking into consideration the large gap between existing and necessary resources to meet the objectives formulated by the governmental institutions in R&D, for instance: "the promotion of excellence in science and technology through a unified system of evaluation of the activities and personnel of R&D units based on international standards; the formation and development of centres of excellence as research units that gather material and human resources of high performance in science and technology and are acknowledged worldwide;

the encouragement and support of training and building a research career; and the acknowledgement of the importance and value of scientists and researchers", it appears that it would be unrealistic and difficult to meet them in a relatively short period of time.

Meeting the ambitious objectives included in the Action Plan for integration into the ERA, for instance: developing the R&D infrastructure in Romania at the European level; granting adequate equipment and facilities to the institutions and universities; developing a network of research labs working in the same or similar fields and having complementary facilities; creating an infrastructure of adequate size having a direct impact on the absorptive capacity of R&D outputs by the economic environment (science and technology parks) at a regional level; developing research centres that are competitive at the European level to attract international programmes and researchers from other countries, especially from Europe; and developing centres or networks of services for R&D (professional training, consulting, technical assistance and information) – all these imply a large volume of investments that cannot be supported from the extremely low funds allocated to R&D in Romania.

The increased volume of funds for R&D, and especially their allocation and efficient use, are even more important in view of the close co-operation between Romania's national research area and the European one, through the facilitation of communication and correlation of activities between researchers in Romania and the EU member states, the openness of the national research programmes to European researchers, the variation of forms and the intensification of the mobility of researchers and professionals in the short and medium term between RDI organisations, universities and industries from member states and candidate countries.

Conclusion

In conclusion, the high absolute and relative gaps between Romania and the EU indicate that we are rather far from closing them. Until a few years ago, the "thematic priorities" in Romanian S&T policy continued to be set according to traditional scientific concerns rather than the meeting of social and economic needs. The current significant improvements, undertaken at the formal and practical level, still have to overcome several barriers. The integration of the Romanian R&D system into the European Research Area, as a major objective of the present period, presupposes not only special financial efforts but the compatibility of information, legislation and management systems as well, and especially the volume of financing with that of the European Union. At the same time, this implies overcoming barriers of communication in R&D, on both the national and international level, that would give a higher value to the national research potential and the statement of Romanian research values, boost firm-level research conditioned especially by the launching of industrial production, increase the contribution of industry to the national effort in research and development, and last but not least, produce a more efficient capitalisation of research outputs in the economy and society. Despite all of this, Romania's high S&T potential and its excellent teams of dynamic researchers currently make it a more attractive area for international co-operation and integration.

References

[1] Romanian Government (2000), Strategia Nationala de Dezvoltare Economica a Romaniei pe termen mediu, Bucharest, p. 31.

[2] Government Programme of Development in 2001–2004, Official Monitor, Part I, No. 700/28-XII-2000, chapter "Scientific Research".

[3] Government of Romania, MER (2001), Romanian Position Paper on the EC Communication "Making a Reality of the European Research Area".
[4] Government of Romania, MER (2003), RDI 2001–2002 Report.
[5] Government of Romania, MER (2004), Romanian RDI System and Activities, Working Material for External Evaluators Group.
[6] EC (1997), The European Report on Science and Technology Indicators 1994, Report EUR 15897, Brussels, Luxembourg.
[7] EC (1997), Second European Report on S&T Indicators 1997, EUR 17639 EN, Brussels, Luxembourg.
[8] EC (2000), Innovation in a Knowledge-Driven Economy. In: Innovation and Technology Transfer, Special Edition.
[9] EC (2000), The Intangible Economy Impact and Policy Issues, RCN 15959. In: CORDIS FOCUS, No. 164/2000, p. 8.
[10] EC (2000), Commission Staff Working Paper: "Trends in European Innovation Policy and the Climate for Innovation in the Union", COM (2000) 56.
[11] EC (2000), 2000 Regular Report, from the Commission on Romania's progress towards accession.
[12] EC (2001), 2001 Regular Report, from the Commission on Romania's progress towards accession.
[13] EC (2001), European Charter for Small Enterprises. In: Innovation & Technology Transfer, No.1/2001, p. 3.
[14] EC (2001), Spain Supports ERA – But With Conditions. In: CORDIS FOCUS, No. 165/2001, p. 3.
[15] EC (2001), Report from the Commission: Research and Technology.
[16] EC (2000), Europe Needs More Than the RTD Framework Programme. In: CORDIS FOCUS, No. 155/2000.
[17] EC (2001), Innovation in EU Candidate Countries: Flight Simulator for Innovation Pilots? In: Innovation and Technology Transfer, No. 6/2001, p. 17.
[18] EU (2001), Special Edition-Indicators for Benchmarking of National Research Policies, Luxembourg.
[19] EC (2001), European Innovation Scoreboard 2001, Cordis Focus Supplement Issue No. 18, September 2001.
[20] EC (2001), Enterprise Directorate-General, The Trend Chart on Innovation, 2000–2001.
[21] EC (2001), Development Activities of the European Union, 2001 Annual Report, Brussels, 12/12/2001, COM92001) 756 final.
[22] EC (2003), S&T Institutions and Policies in the EU Accession Countries – Challenges for the Development of the Knowledge-Based Economy, Blaž GOLOB, draft.
[23] EC (2004), Towards a European Research Area – Key Figures 2003–2004.

E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 12

A National Science and Technology Policy Overview: Greece 2004

Dr. Dimitris DENIOZOS
General Secretariat for Research and Technology
Ministry of Development, Greece

Abstract. During the last four years, the Greek research, technology and innovation policy marked a significant turn in favour of innovation and the creation of conditions for effectively linking economic and social development to the research activities of public institutions, while at the same time encouraging the establishment of RTD activities in business enterprises. The structural change undertaken has been supported by funding from national and community sources (regional and social funds) as well as by private funding expected to exceed 35% of the total budget. The model has its limits in fulfilling the "demand for knowledge" by the business and public sectors to produce and market new products and services.

1. Policy Orientation and Priorities

The common denominator in the policies of the last 10 years is the funding support of projects implemented by universities, industry or university-industry consortia. The period 2000–2001 was extremely important for the definition of a multi-layer science, technology and innovation (STI) policy in Greece, supported to an important degree by the EU Structural Funds. The transition had to be made from a structural policy that emphasised the development of research facilities to one that focused on the exploitation of research results, the development of material and financial infrastructures to host spin-offs and NTBFs, and the establishment of long-range links between the public research and business sectors for the provision of knowledge-intensive services. The new period has also seen more emphasis on international co-operation through funding of projects and active participation in European organisations.

The major influences on the Greek STI policy are: a) concerns about increasing trade deficits and the competitiveness of national industry, which animate a debate on the mechanisms to generate a virtuous circle of development; and b) discussions and decisions at the EU level on the competitiveness of the European economy as a whole and on the role of Greece and the Mediterranean and Central European countries in the endeavour to make Europe the most competitive area in the world by 2010.

The idea of making Greece a "knowledge-intensive" economy is gradually being accepted and this is reflected through incentive schemes and programmes. The main political parties included innovation as one of their platform priorities in view of the March 2004 elections. At the same time, innovation has penetrated regional development policies and become an important concern of the European Regional Development Fund, which has an important say in the elaboration and approval of the structural operational programmes co-financed by the EU Structural Funds. The Federation of Greek Industries is now considering innovation as an issue related to the competitiveness of member companies.

The main priorities are the following:

- Increase the demand for new knowledge and research results in Greece;
- Reorganise the research system towards a knowledge-based economy in Greece;
- "Open up" the Greek research system and open it further to the international arena;
- Improve the RTD infrastructure;
- Focus on selected thematic priorities and promote technology foresight;
- Increase the Gross Expenditure for RTD (GERD) as a percentage of GDP from 0.65% in 2000 to 1.50% in 2010, and increase the business-financed GERD from 25% of GERD to 40%.

These general priority guidelines are analysed as follows:

Increase the demand for new knowledge and research results in Greece.

- Increase investment in knowledge-intensive sectors and re-orient production towards RTD demanding high-added-value products and services;
- Create new business activities through exploitation of knowledge and research results;
- Attract business activities from abroad;
- Increase the employment of research personnel in business;
- Improve the collaboration between public research organisations and business firms;
- Raise public awareness about science.

Reorganise the research system towards a knowledge-based economy in Greece.

- Reorient the priorities of public RTD institutions towards societal and business sector needs;
- Strengthen academic research to support the education and training of young researchers;
- Increase the "critical mass" of research units;
- Promote excellence;
- Improve the management of research organisations.

"Open up" the Greek research system and open it further to the international arena.
Promote international S&T co-operation through:

- Participation of Greek teams in FP6;
- International RTD organisations;
- Bilateral and regional activities;
- Opening up of the national RTD Programmes.

Improve the RTD infrastructure.

- Improve electronic networks and other research infrastructures;
- Improve the national patent and IPR system;
- Facilitate access of information included in patents.

Focus on selected thematic priorities and promote technology foresight in the following areas:

- Renewable energy sources;
- Natural environment (atmospheric, marine, water resources, forest fires, recycling);
- Knowledge-intensive culture and tourism;
- Health, biomedicine, diagnostic and therapeutic methods;
- Built environment and earthquake protection;
- New forms of organisation for businesses;
- Sport;
- Food technologies – aquaculture;
- Sea transport;
- E-learning;
- E-business.

In this framework, the main components of the STI policy include the following schemes:

- Creation and development of private S&T parks and incubators;
- Exploitation of public research results, at the initiative of the researchers themselves, private financing institutions, companies or individuals;
- Development of venture capital with the support of a public fund or funds;
- Organisation of the supply of knowledge-intensive services by public laboratories to industry on medium- and long-term bases;
- Training of research directors in the public and private sectors, and promotion of opinion-makers and young researchers into the management of innovation and research;
- Foresight exercise;
- Promotion of entrepreneurship in schools and universities.

These measures complement already existing schemes for supporting the following:

- Industrial research and demonstration;
- International co-operation in industrial research;
- Co-operative RTD through projects implemented by consortia of research and productive institutions;
- Training of young researchers in projects co-financed by industry;
- Employment of researchers from abroad in projects co-financed by industry;
- Familiarisation of the public with scientific and technological change.

The majority of the above measures are included in one programming document – the Operational Programme for Competitiveness. Additional measures are found in the Operational Programme for the Information Society (OPIS) and for Education (OPEIVT), as well as in some regional operational programmes. These measures were conceived during the elaboration of the Common Support Framework, which is the umbrella document for all of the operational programmes.

Increase the Gross Expenditure for RTD (GERD) as a percentage of GDP from 0.65% in 2000 to 1.50% in 2010, and increase the business-financed GERD from 25% of GERD to 40%.

- In view of the Lisbon and Barcelona objectives, Greece declared its will to move from a poor 0.65% GERD/GDP to a modest 1.5% by 2010, with business-financed GERD increasing to 40%[1]. The translation of these targets into operational figures shows the size of the challenge: from 55,000 research personnel in 2000, 125,000

[1] Souitaris, Vangelis: Strategic Influences of Technological Innovation in Greece, British Journal of Management, Vol. 12, 131–147 (2001).

should be achieved by 2010. The additional 70,000 should include approximately 35,000 researchers, which means that 3,500 to 4,000 new (additional, not including replacements) qualified researchers should enter the national research system annually, compared to 1,000 to 1,200 during the 1990s. The rate of increase of researchers (FTE) between 1996 and 1999 was 11% in Greece (the highest in the EU-25, with the EU-15 average being 3.9%), but this is not sufficient to achieve the set goal[2].

- The GERD/GDP ratio stagnated between 1999 and 2001 at around 0.65%. A high rate of increase marked business expenditures (16.7%, 1997–1999), which started from a very low level, while government funding increased by only 2.1% (1997–2001). Due to this evolution, the share of industry financing of GERD increased from 24% in 1999 to 30% in 2001. An interesting characteristic of the Greek system is the high share of foreign funds financing R&D: 20.6% in 1999 increased to 21.4% in 2001. This is due to an influx of contracts from community sources, mainly the Framework Programme and the EU Structural Funds (approximately half for each). The latter are less “international” than “national”, since the funding is fully managed by national authorities and institutions.
- On the “performance” side, the universities covered 49.5% of expenditures in 1999 and 45.5% in 2001. The universities also showed the lowest R&D expenditures per researcher (FTE) among the EU-15 and other sectors of R&D performance (Greek government institutes – 51% of the EU-15 average, industry – 45%, universities – 37%). This is a major source of difficulty in concentrating the already limited resources to a few effective targets, sustained also by the distortions of the educational system: the share of new Ph.D.s in science and engineering fields per thousand population aged 25–34 in 2001 was only 0.19%, while Sweden’s level was 1.37% and the EU-15 average was 0.55%. In average annual growth, Greece showed a rate of 8.3% for the period 1998–2001, which exceeds that of the EU-15 (2.4%) and equals Sweden.

The forecasts have not yet impacted the national policy, and it remains to further analyse them and establish precise operational targets for each existing and potential actor in the innovation and research system. For the moment, the stakeholders persist in embodied technology transfer and the government has put more energy and effort into supporting this policy. The tools put in force by the government are those of the period 2000–2001, before the introduction of the Barcelona objective, and include:

– The Operational Programmes of the Common Support Framework (OP for Competitiveness, for the Information Society, for Education and Initial Training, for Employment and Continuous Training, the 13 regional OPs, etc.). In the past (1994–1999), R&D in manufacturing received 1.4% of all Greek state aid to manufacturing through these programmes; the corresponding figure for the EU-15 was 19.2%.

– The legislative framework on encouraging private investment, taxation of R&D spending, venture capital, research and technology, patenting and IPRs, education and training, and membership in European and international S&T institutions (i.e. EPO, ESA, etc.).

The educational and training level of entrepreneurs, the dominance of public sector regulatory and purchasing roles in the economy compared to internal market dynamism, and the reactivity of the educational system to changes – these are handicaps that counter-

[2] Souitaris, Vangelis: Strategic Influences of Technological Innovation in Greece, British Journal of Management, Vol. 12, 131–147 (2001).

Table 1. Comparable Indicators of Economic Performance.

Indicator – 2003 or Latest Available Year	Greece	EU-15 Average
Industry-Financed GERD, 1999–2001	29.7%	55.9%
GERD Performed by the Business Sector, 1999–2001	31.9%	64.9%
R&D Expenditure Financed from Abroad, 1999–2001	21.4%	7.7%
GERD Performed by the Education Sector	45%	21.2%
Total Researchers per 1000 Total Employed, 1999	3.7%	5.6%
Business Enterprise Researchers as % of National Total, 1999	15.2%	50.4%
Business Enterprise Researchers per 1000 Employed in Industry	0.7%	4.0%
R&D Expenditure (in thousands of €) per Researcher (FTE), 2001 Total	54	171
Inward FDI Average, 1999–2001	0.9	6.9
Share of SMEs in Publicly Funded RTD Executed by the Business Sector	70.6	15.1
New S&E Graduates in Greece, 1993	9.9	10.3
Work Population with 3rd Level Education, 2002	17.6	21.5
EPO High-Tech Patent Applications per Million Population	2.1	31.6
USPTO High-Tech Patent Applications per Million Population	0.4	12.4
EPO Patent Applications per Million Population	7.7	161.1
USPTO Patent Applications per Million Population	3.4	80.1
Innovation Expenditure, Manufacturing	2.22	3.45
Innovation Expenditure, Services	1.60	1.83
High Tech VC, Share in Investment	27.9	45.4
Early Stage VC / GDP	0.017	0.037
New to Market Products, in Manufacturing, % Turnover	4.4	10.5
New to Market Products, in Services, % Turnover	17.9	7.4
Internet Access / Use (Number of Households)	0.05	0.51
ICT Expenditure % of GDP	5.1	7.0
VA High-Tech Manufacturing / Total VA in Manufacturing	6.3	14.1

Sources: OECD: Main STI 2003/2; European Commission: Key Figures 2003–2004, 2003; European Innovation Scoreboard 2003; European Commission: 3rd European Report on S&T Indicators, 2003; European Commission: Key Figures 2003–2004, 2003; European Commission: A New Partnership for Cohesion, 2004

balance any efforts for effective convergence of Greece with the most advanced countries of the EU. These efforts must be founded on the most dynamic and extroverted parts of the population, which need to create positive paradigms for the rest of the society and its economic life. Cultural values need to be re-assessed in order to keep the most positive for competitiveness, such as entrepreneurship and creativity, and shrink the weight of insecurity in risk taking and the conformism to established institutions, while clarifying the confusion between social justice and equal access on one side and uniformity and homogeneity on the other.

Creating a new breed of “knowledge entrepreneurship” will change the landscape of the SMEs, which are identified at present by their low educational level and mediocre quality of services and manufacturing. A cultural change in education is probably more urgent than ever, but despite all political parties claiming education as a top priority, their objectives remain conservative or unclear.

Academic research on research and innovation in Greece is not particularly rich. Two relatively recent papers analyse various aspects of its problems. The first finds that top management characteristics proved more important “strategic” influences of innovation for Greek SMEs than corporate practices, while the highly innovative companies were the ones to overcome country-specific innovation barriers such as the low supply of technology, the low level of competition and the risk-wary national culture.[3] The second paper finds that during the period 1948–1980 public investment spending exerted a positive effect on private investments, while during the period 1981–1996 the relation became negative.[4]

2. The National System of Research, Technology and Innovation

The main organisations explicitly involved in STI policy are the Ministry of Development (MoD), through its General Secretariat for Research and Technology (GSRT), and the Ministry of the Economy and Finance (MEF), through its units for Private Investment, Public Investment and Fiscal Policy. The instruments they use for policy elaboration and implementation are:

- The legal framework (laws, presidential decrees and ministerial decisions) on incentives to private investment, taxation of business firms, operation of public research centres, financing R&D and exploitation of public R&D results;
- The multi-annual programming documents, accompanied by rules for implementation, monitoring and control, and related to incentives to private investment, R&D, creation of technology transfer mechanisms and the like.

In the private sector, the bodies expressing the collective needs and strategies of individual business firms are the Federation of Greek Industries and the Federation of Industrialists of Northern Greece. The National Competitiveness Council, an advisory body to the minister created by the Ministry of Development in 2003, groups representatives of the government and the private economy under the same roof. This new body gives a more institutional and systematic character to co-operation between the government and business sectors. Intermediary bodies are less developed and, wherever they exist, stem from public political and legislative initiatives while operating under a "private" legal regime for flexibility purposes.

The GSRT has worked since the early 1980s promoting innovation and elaborating its own funding schemes and legal instruments, while gradually changing its focus from R&D funding to supporting the exploitation of research results. The GSRT "supervises" 11 research centres of relatively small and medium size, six small corporations promoting the diffusion of technology and technology services in specific areas of economic activity, the Patent Office of Greece and a Technology Museum.

Since these organisations stem from different periods of Greek economic history, they bear different cultures and internal dynamics. Supervision of the R&D centres means regular institutional funding (among other things), while other organisations are supported only through project funding. Among the R&D centres, the older breed (established before 1975) has been conceived as a "public service", addressing to a great extent issues of environmental study and protection, social and socio-economic development, health, security and the like. The new breed (established after 1980) aimed at rationalising public research traditionally dominated by the universities and is accelerating the pace for bringing Greek public research closer to the EU average. The common legal framework for operating these centres and the common rules for project funding have contributed to reducing the age gap of the two generations. A document issued in early 2004 raises serious questions about the future role of the centres in relation to the universities and private business services.[5]

[3] Souitaris, Vangelis: Strategic Influences of Technological Innovation in Greece, British Journal of Management, Vol. 12, 131–147 (2001).

[4] Apergis, Nicholas: Public and Private Investments in Greece: Complementary or Substitute Goods, Bulletin of Economic Research 52:3, 2000.

[5] GSRT: Towards the Economy of Knowledge, Athens 2004.

The MoD and its GSRT are assisted by an advisory body in policy-making and management of research institutions: the National Council for Research and Technology (NCRT) advises the government on national R&D priorities and on the selection and appointment of research centre upper management (selection of the directors of the centres and their institutes).

The MoD also oversees industry, energy and natural resources, consumer protection and internal (EU) trade. Through the General Secretariat for Industry (GSI), it may have an impact on SME creation and development as well as standards (supervises the Greek Standards Organisation, the National Certification Council and the National Metrology Institute).

The MEF defines the macro-economic policy for Greece within the ECOFIN and ECB guidelines and rules. Moreover, it manages the incentives to private investment, including grants to investors or subsidisation of loan interest. The legal framework provides for special support to innovative companies and to investments in high-technology products and services. This set of schemes has been improving for the last two decades and is going to be reassessed soon, according to a government statement. It has encouraged the modernisation of the industrial sector and the growth of the software industry in the country, but it has not proven satisfactory for attracting foreign direct investment. Greece remains a laggard in FDI among the EU-15, and this is considered a main negative factor in convergence policy.

At the tax policy level, the MEF has offered accelerated amortisation for investment in R&D equipment (1987) and tax reduction for R&D expenditures at the rate of 50% from taxable profits (2002) to induce more "creative" business strategies. The MEF is also preparing the policy for regional development and implementing it through the operational programmes co-financed by the EU Structural Funds. The 2000–2006 Operational Programmes for Competitiveness (OPA) and for the Information Society (OPIS) provide for relatively limited funding to innovation and R&D oriented to economic needs. The share of R&D and innovation funding in the OPA is as low as 10% (€640 million, of which 38% is expected private contribution) and in OPIS much lower. The bulk of the programmes are dedicated to public and private investment based mainly on embodied technology transfer. The regional operational programmes are also expected to support innovation with limited funding through local measures, some of which will be co-managed with the GSRT, for the transfer of organisational know-how.

The main performer of R&D is the university system (close to 50% of the national effort), which is under the supervision of the Ministry of Education. The educational policy of this ministry impacts only indirectly the research activities of the universities and technological colleges, through the creation of new departments and graduate programmes and the nomination of new professors. Nevertheless, the whole system operates "bottom up", so the orientation of research activities depends on the personal strategies of the professors and the leverage effect of various project funding schemes of the GSRT, the EU, industry or other ministries. This is the basic reason for the fragmentation of research in the universities and in Greece in general.

Other public authorities with potential impact on innovation policy and the innovativeness of the economy are the Ministry of Agriculture and Food, the Ministry of Public Works and the Environment, the Ministry of Transport and Communications, The Ministry of Health and the Ministry of Defence. The Ministry of Agriculture operates a National Centre for development and dissemination of knowledge in the agricultural and food sectors. The Ministry of Public Works operates public works (testing) laboratories and in the past launched a scheme supporting environmental R&D. The Ministry of Transport and Communications co-operates with the independent authority for telecommunications, setting rules for the dissemination of ICT technologies, while playing a central role in the exploitation of satellite potential by introducing new services. Also, important clients for

Table 2. Government R&D Appropriations by Ministry, Latest Available Year (in millions of €).

	1999	%	2001	%
Ministry of Education	190.0	54	220.9	53
Ministry of Development	123.0	35	152.5	37
Ministry of Agriculture	25.3	7	26.7	6
Ministry of Defence	3.0	1	3.0	1
Ministry of the Economy and Finance	3.7	1	4.1	1
Ministry of Culture	2.1	1	3.1	1
Other Ministries	2.4	1	3.3	1
Total	349.5	100	413.6	100

Source: GSRT

space technology may be the Ministry of the Merchant Marine, the Ministry of Tourism and the Ministry of Defence; the latter operates a few research units of extremely small size compared to the volume of armament Greece purchases from mainly foreign suppliers.

The business sector is the weakest component of the national innovation system. Composed of very small and for the great majority traditional firms, it is slow to adopt process innovations (through purchase of embodied technology) and even slower to develop its own technological base. A very high share of the business expenditure for R&D is based on ICT firms established in the last two to three decades. During the period 1998–2000 (latest data available), the number of innovative companies increased considerably and reached 27.3%.[6] This rise was mostly due to the service sector, while manufacturing, and in particular very small firms, showed a more conservative profile. This increase was insufficient to rapidly reduce the gap with the EU average, where Greece is the last performer among the 15 member states.

Recognising the failures of both the civil service sector and the market, the government adopted initiatives in the past to develop intermediary institutions, improving the administrative context for both operating public R&D and disseminating know-how and technology. In the early 1980s, the “special accounts” freed university and other public researchers from dysfunctions of the public accounting and financial control system. This has been a quasi-private legal institution, which operates inside public service organisations. The structural programmes since the late 1980s have supported technical R&D semi-public corporations, university and research centre liaison offices, technology brokers, public-private R&D consortia funded on a project basis, and the creation of S&T parks near research centres. Since 2001, the structural programmes have tried to give support to private initiatives for development of intermediary institutions, expecting higher management efficiency from private stakeholders.

The GSRT has been an active catalyser of decisions favouring innovation in the other general secretariats of the Ministry of Development and other ministries. The GSRT could also use the opportunities created by the debate in the National Competitiveness Council to promote innovation in manufacturing, energy, commerce and tourism. Nevertheless, innovation has not always been the first priority of the GSRT policy. Lobbies contributing to the elaboration of GSRT policies having a strong academic segment have often lead to decisions of absolute support for “free” research. Discontinuity in the GSRT innovation policy has been commonplace in the last 20 years.

Similar internal controversy is seen in MEF policies. The approach of supporting any private initiative for investment, which so far has favoured the reproduction of the traditional industrial morphology, has very influential supporters who perceive innovative and knowledge-intensive investments of rather exceptional character in comparison to the actual strategic behaviour of investors persisting on the transfer of embodied technology. The

[6] GSRT: CIS 3: Measurement of Innovation in Greece 1998–2000, Athens 2004 (in Greek).

arguments are very strong from both sides, given the present capabilities of the majority of Greek entrepreneurs and the labour force. Limited confidence in the potential of the research system has lead to a policy mix that until now marginalises innovators and high-technology investors. The recommendations of the Centre for Planning and Economic Research (KEPE), which is an important MEF advisor in preparing the Regional Development Plan, have contributed to putting more emphasis on incentives to traditional investments rather than innovative ones.

The third important player in this scenario is the Ministry of Education, where the policy-making structures are concentrated around the Cabinet Office and the general and special secretariats, while the civil service sector lacks the necessary think-tank for policy elaboration, in particular for tertiary education and lifelong learning. As a consequence, the universities are only responsible for research orientations and priorities and for the supply of fresh knowledge to the marketplace.

At the same time, the universities are bound by a legal framework based on educational contingencies that impose homogeneous structures and decision-making procedures, making the transition from a traditional "Humboldtian" organisational model to one more responsive to market and societal needs extremely slow. Since changes in university structures have to be made centrally, or at least permitted by central decisions, much may be done because of the university policies redesigned at the European level. Until then, the universities will continue to operate as very loose institutions, the members of which operate as professionals whose only tying bonds are the provisions of the undergraduate curriculum. This leaves active researchers free to pursue growth strategies for their laboratories thanks to: a) funds stemming from programmes of the GSRT, other ministries, the European Commission or the private sector; and b) the managerial flexibility allowed by the "special accounts" functioning in each university.

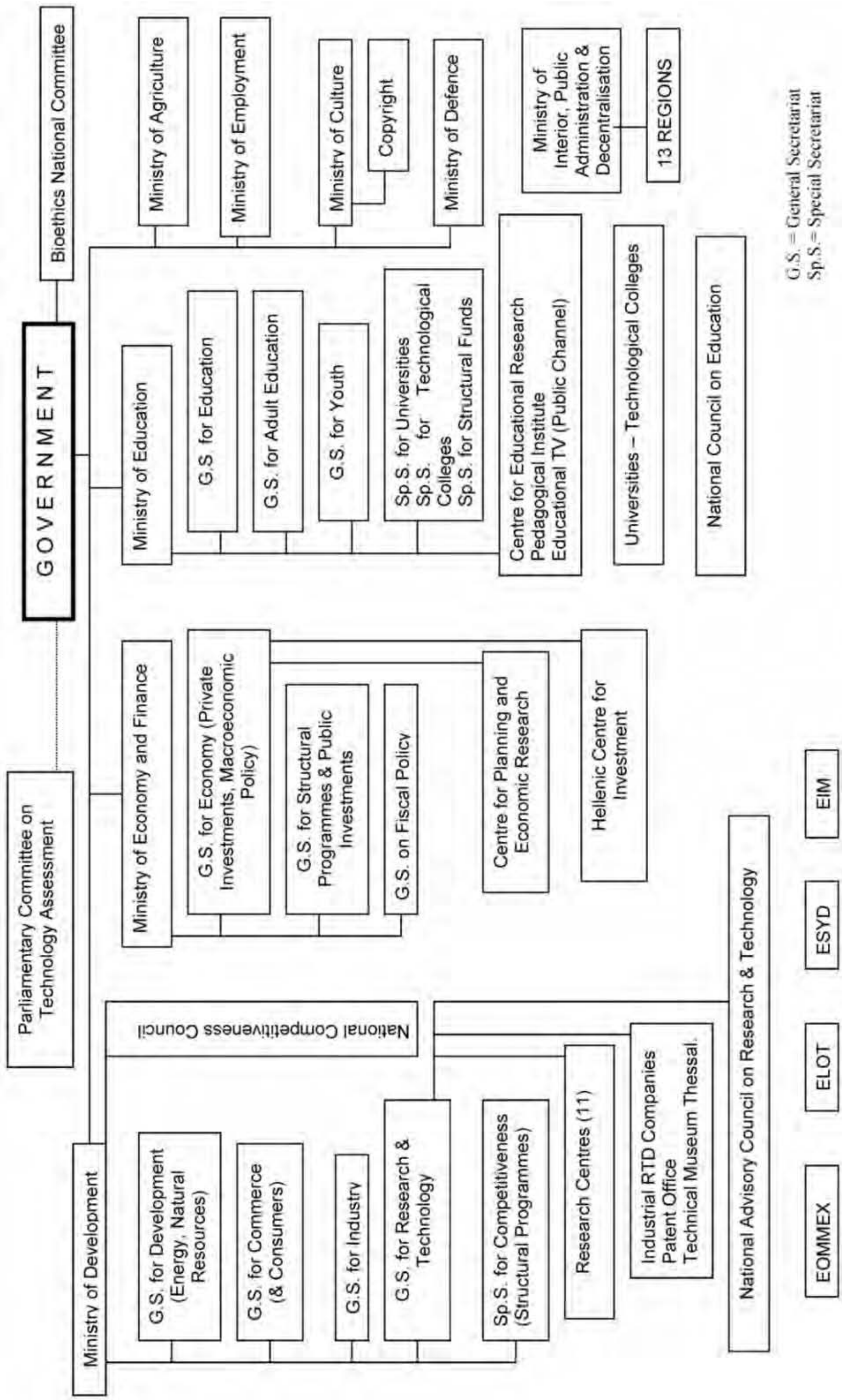
Much of the problem of fragmentation in the RTD landscape is due to the rapid increase of university professors for teaching purposes who in recent years dominate the research orientations. The co-ordination therefore has a bottom-up direction rather than the opposite. A debate is open from time to time as to the need for co-ordination though an inter-ministerial committee, and it seems probable that such a committee will be established by the newly elected government. Such a committee was created a few decades ago under the chairmanship of the Prime Minister and met twice in four years before it was abolished.

At the implementation level, the MoD-GSRT is again the most important institution, responsible for overseeing:

- Supervision of research units, technological service firms and the patent office;
- University and industrial RTD funding;
- Qualifications of investment applications for MEF funding based on incentives to innovative and high-technology ventures.

Limited human and financial resources prevent the capabilities of GSRT from having a recognisable impact on the economy. Moreover, its strategies are rather simple, because the staffing and level of development of its partners (universities, industry) do now allow for complicated objectives, timing and assessment procedures. Efforts during the last 20 years to develop intermediaries out of existing organisations (Organisation for SMEs and Handicrafts, Productivity Centre, Industrial Development Bank), did not survive their initiation. The latest version of the Operational Programme for Competitiveness is pushing through incentives to private operators (S&T parks and incubators, technology brokers, venture funds, university liaison offices) to play a significant role as intermediaries.

Along a parallel line, the MoD recently announced that it will support the development of "Regional Poles of Innovation", an initiative that will be made public in the coming months and managed most probably by the General Secretariat for Industry (GSI).


GOVERNMENT
Parliamentary Committee on Technology Assessment
Bioethics National Committee
Ministry of Development
G.S. for Development (Energy, Natural Resources)
G.S. for Commerce (& Consumers)
G.S. for Industry
G.S. for Research & Technology
Sp.S. for Competitiveness (Structural Programmes)
Research Centres (11)
Industrial RTD Companies
Patent Office
Technical Museum Thessal.
National Competitiveness Council
National Advisory Council on Research & Technology
EOMMEX
ELOT
ESYD
EIM
Ministry of Economy and Finance
G.S. for Economy (Private Investments, Macroeconomic Policy)
G.S. for Structural Programmes & Public Investments
G.S. on Fiscal Policy
Centre for Planning and Economic Research
Hellenic Centre for Investment
Ministry of Education
G.S. for Education
G.S. for Adult Education
G.S. for Youth
Sp.S. for Universities
Sp.S. for Technological Colleges
Sp.S. for Structural Funds
Centre for Educational Research
Pedagogical Institute
Educational TV (Public Channel)
Universities – Technological Colleges
National Council on Education
Ministry of Agriculture
Ministry of Employment
Ministry of Culture
Copyright
Ministry of Defence
Ministry of Interior, Public Administration & Decentralisation
13 REGIONS
G.S. = General Secretariat
Sp.S.= Special Secretariat

In recent years, under the encouragement of European Regional Development Fund (ERDF) officials, regional "governments" have developed innovative segments in their regional development plans.

3. Regional Innovation Systems and Policies

The 13 regions in Greece were created 15–20 years ago to elaborate and implement the multi-annual operational programmes (OPs) – one per region. More responsibilities have recently been transferred from the central government to the regions. The operational programmes draw mainly from the traditional perception of regional development based on the construction of public infrastructures (transports, energy, irrigation, schools, hospitals, etc.). It is only recently, and after several initiatives from the European Commission and competent national authorities, that the regional operational programmes provided for supporting innovative measures.

Half of the 13 regions are in a position to elaborate an innovation policy and develop mechanisms to implement it. These are the most populated regions, with large universities, research centres and consequent productive activity. In regions dominated by agriculture and leisure-tourism activities, the priorities of the economic stakeholders are oriented quite exclusively to embodied technology transfer. The first group of regional administrations has acquired some experience from the studies on innovation strategy undertaken in the last decade under the impulse of various EU initiatives. The studies stimulated the awareness of local stakeholders and used the research institutions for advice and support. Some of the regions have financially supported the construction of research facilities and public incubators. Nevertheless, there are significant difficulties with regard to elaborating and implementing schemes for the support of private initiatives due to the complexity of community rules on state aid.

According to the 2003 European Competitiveness Report, one Greek region (Sterea Ellada) ranks 5th among all EU-15 regions in productivity level, while another (Thraki) ranks 5th from the bottom.[7] Both regions show low levels of R&D financing, with the particular future of Thrace, thanks to the public university operating on its soil and its low GDP, demonstrating a GERD/GDP close to 1%. Seven of the 13 Greek regions are among the top ten in regional productivity growth rates. Ipeiros, due again to its local university, shows the highest GERD/G(r)DP ratio (1.5%), while the islands of Notio Aigaio show the lowest (0.1%). Despite these discrepancies, the gaps between the Greek regions are smaller in GDP per capita as well as in RTD expenditures than in other EU member states, in particular the most developed ones.[8]

4. Specific STI Policy Issues

4.1. Education and Training

The training of researchers in academia as well as in industry is proving to be of very high urgency for the successful implementation of the objectives of the knowledge-based economy. The tools are adapted to not only achieve quantitative targets but also to create a generation of researchers that will support excellence and be able to support the links between research and innovation.

[7] http://europa.eu.int/comm/enterprise/enterprise_policy/competitiveness/doc.

[8] European Commission: A New Partnership for Cohesion, Convergence, Competitiveness and Co-operation, Third Report, Feb. 2004.

Moreover, management training and general issues of integrating RTD into business and social development processes, along with the introduction of professionalism in policy-making and implementation, are crucial for economic and social development. A massive operation was needed to disseminate basic principles and good practices among managers and opinion-makers. The measure launched in 2003–4 provides for 100% support to institutions and expert teams that organise such training. The instructors and curricula will be selected based on the criteria of past performance, compatibility with the needs of the target population and cost. International co-operation with expert institutions is encouraged. The target population also includes opinion-makers and, to a lesser extent, young researchers.

The ENTER Programme is probably the most important scheme favouring mobility of researchers from abroad to Greece; it replaced an older scheme addressing the repatriation of Greeks from the diaspora. Several programmes of international co-operation may have an indirect impact on mobility. Mobility between academia and industry is supported indirectly by various schemes, such as the support of researcher employment by industry, the creation of spin-off firms by researchers, and industry/academia consortia.

The Ministry of Education launched an ambitious programme for modernisation of the educational system at all levels of education, vocational training and training of instructors for the period 1995–2000 that will continue after 2000 until 2006. New universities were announced in various cities of the country that offer new perspectives for regional development. In the 2000–2006 version of the programme, a new sub-programme has been scheduled on the "encouragement of entrepreneurial action and innovative applications" providing organisational and financial support for creating information portals for interested young persons and introducing "entrepreneurship" courses in universities.

These measures could probably limit the risk aversion of the dominant culture in Greek families, especially those that are not involved in successful business activities. The raising of awareness on S&T and innovation has become a major topic in GSRT policy, due to the need for the general public and opinion-makers to understand the knowledge-based economy. The measures launched in the past are still in force, while their implementation has not yet begun. A new Technical Museum and Centre for the Dissemination of Technologies in Thessaloniki has opened its doors to the general public; it aims at becoming a major attraction in the Balkan area. In addition, the Athens Planetarium has introduced new display technologies that attract a large number of visitors. A scheme for networking business people and academics is also ongoing.

4.2. Initiatives to Increase the Demand for Knowledge and RTD Results from Industry

The PRAXE Programme has committed a budget of €9 million to support researchers and research institutions with seed money to draft business plans, etc. Another €27 million in public funding (to be matched by equal private funds) is channelled directly to established spin-off firms.

The ELEFTHO Programme promotes the creation and development of privately owned S&T parks and incubators. Those incubators already approved for financial support have the capability to house and advise new technology-intensive companies as well as participate in the stock capital of firms and operate as venture capitalists. At the same time, in the six regions with the most developed public research capacity, the institutions concerned (universities, technological colleges, research centres and S&T parks) started developing, raising the awareness of local authorities on the links between innovation and economic development.

At the legislative level, the Law on Incentives to Private Investment for Economic and Regional Development has been modified beginning in 2004, and the qualification for grants to innovative manufacturing firms covers the exclusive production of new products or products of advanced technology. Indirectly, VC support and measures for raising the awareness of students also support the same type of firms.

4.3. Promotion of Clustering and Co-operation for Research and Innovation

The "RTD Consortia" Programme contributes positively to the aggregation of public research units and business enterprises around technological issues of common interest.

The AKMON Programme also brings together public research units and industry, probably with longer-term effects. A "Human Networks" Programme, bringing together experts from academia and industry, may also have indirect impact on clustering, particularly between public and private organisations.

4.4. Strategic Vision of Research and Development

The strategic vision of RTD is supported by the ongoing National Foresight Exercise. Moreover, the need to achieve the Barcelona objectives for Greece, as adopted by the Greek government, is generating a debate on the priorities for financing and the mechanisms to use. The RTD strategy has been oriented until now mainly by "horizontal" priorities – to create appropriate infrastructures and mechanisms of a general character. The selection of thematic priorities at the national level has proven much more difficult and risky due the limited involvement of the business and public-user sectors.

The main instrument for raising the industrial contribution to the RTD effort has been (for 15 years) the Programme for the Advancement of Industrial Research (PAVE). Practice has shown that most projects were elaborated and implemented by public researchers as company subcontractors, with minimum involvement of the company. The scheme was split into five other schemes with more targeted goals. The first one provides for funding to young firms (independent and less than 5 years old) on the same terms as PAVE; the programme was named PAVET-NE and is a successor of the previous one. The second provides for the employment of research personnel by companies (up to five people, of whom three are Ph.D. holders, for 3 years). The third is the Programme for Supporting Demonstration Projects (PEPER), while the fourth promotes international co-operation in industrial research and creates opportunities for the participation of Greek firms in EUREKA. The final programme is the already mentioned "RTD Consortia".

In brief, the package of schemes for increasing industry financing of RTD contains the following:

- HERON for the employment of research personnel in companies;
- PAVET-NE for the implementation of RTD by young firms;
- PEPER for demonstration of new technologies;
- International co-operation in industrial research;
- "RTD Consortia" (see also above) for jointly producing useful knowledge by industry and academia in areas of national priority.

5. A Challenging Future

According to the OECD STI scoreboard, Greece ranks last among EU member states in investment in knowledge (RTD, software and higher education) with a share lower than 2% of GDP in 2000, while the EU-12 average is close to 4%.[9] The average annual growth rate

[9] OECD: STI Scoreboard: Creation and Diffusion of Knowledge 2003; EU-12 not including BE, DK, GR.

during the period 1992–2000 is estimated at 1.8% for Greece, while the EU-12 average is 4.2%. The "gross fixed capital formation" as a percentage of GDP in Greece and the average annual growth rate for the same period are similar to the EU average. These indicators show that the challenges for the government and private enterprise are extreme and require the mobilisation of all forces of the country to build a new basis for sustainable economic growth. They first require the acceptance of the role of knowledge in economic and social development and international competitiveness; second, the society has to understand that the dissemination of knowledge is strongly linked to, and its effectiveness dependent on, the capacity for the production of knowledge.

This page intentionally left blank

CHAPTER 13

Central European Countries

This page intentionally left blank

Modernisation of Science Policy and Management Approaches in Central and South East Europe
E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

Reforms in the Field of Research, Development and Innovation in Hungary

Dr. Zoltán PEREDY and Dr. habil. József IMRE
Ministry of Education, Budapest, Republic of Hungary

Abstract. Due to its forthcoming EU Membership, the Hungarian R&D sector faces new challenges both on the domestic and international level. To answer these challenges, Hungary has to carry out serious reforms in the field of R&D and technology innovation. In this paper we would like to focus on restructuring elements of the Hungarian innovation system.

1. Situational Analysis of Hungarian Research, Development and Innovation

Nowadays it seems trivial, but the statement that research, development and innovation are key dynamic elements of the transition to a knowledge-based economy is more correct than ever. Long-term economic competitiveness is simply impossible without a stable and continuously developing knowledge base and utilisation of new scientific and technology results in the economy.

Hungary has an internationally recognised, high-level research tradition at the university and academic level and a good track record in natural sciences, engineering and medical sciences [1–3,6]. Despite the fact that Hungary has well-recognised scientific potential, strong intellectual resources and extensive international scientific relations in some dynamically developing areas, its knowledge base plays a smaller than expected role in contributing to the performance and competitiveness of the national economy. This fact can only be partially explained by its obsolete R&D infrastructure and its relatively low number of researchers compared to Europe. The innovation infrastructure and institutional system are suffering from some shortages, and the networks supporting knowledge transfer between the knowledge base and the business sector are inadequate. Foreign-owned enterprises have recently made a few contacts with the Hungarian R&D sector. The innovation capabilities of Hungarian enterprises, primarily SMEs, are generally low. There are few R&D investments. These processes are all reflected in the fact that R&D expenditures as a percentage of GDP are lower than the desired level or the EU average and that R&D is predominantly state funded (see Fig. 3).

Competitiveness in the Hungarian economy is particularly dependent on the SME sector [2]. Their better technology, improved management skills, improved opportunities in the capital market, better business infrastructure, and the development of their e-capacities to help communication with their environment and business partners leads to higher value added and considerably strengthens their overall competitiveness. There is significant potential to develop better supply links between SMEs and large firms so that they could integrate better into international markets. More intense innovation and new human-resource and management knowledge are important necessities for SMEs. The strengthening of the development of new products, technologies in R&D centres, and co-operation between the public and private sectors is extremely important. These actions should be predominantly carried out outside the capital, where R&D activity is low and there is underused local potential to pursue research at regional centres (e.g. universities). The dissemination of research results is particularly helpful to the increased competitiveness of the regions. Increasing the benefits from local and regional potential and the accessibility between and within regions would be desirable for increased competitiveness. New social and business links could contribute to the improvement of local competitiveness. The improvement of local administration, the rehabilitation of brown-fields, and the establishment of better networks between local universities and the business sector could change the current situation.

The role of R&D in contributing to better use of labour resources takes several forms. The low level of aggregate and corporate R&D activities and spending in Hungary restrict the competitiveness of the country. The improvement in R&D spending and enterprises' own R&D activities help competitiveness and improve labour demand. A well functioning R&D system directly contributes to a higher quality workforce and better employability in the field of industry. Improvement in the research activities of enterprises serves the creation of new jobs with a high quality workforce that pursues high value added activities.

The following SWOT analysis in the field of technology and innovation summarises the aforementioned major facts [4]:

Table 1. SWOT Analysis of the Hungarian Economy and R&D Sector.

Strengths:	Weaknesses:	Opportunities:	Threats:
• Internationally recognised, high level research tradition at university and academic level • Good track record in natural sciences, engineering and medical sciences • International companies with R&D activities are locating into Hungary • Research integrated into international R&D networks (Sixth Framework Programme)	• The amount of R&D expenditures is low • R&D is predominantly state funded • R&D infrastructure is obsolete and the research staff is an aging population • The innovation activity of the corporate sector is low • The link between the R&D sector and businesses is weak: spin-off activity is low	• A closer economic integration with EU countries • Increasing demand on the faster spread of results in the field of R&D • Rapid development of high-technology sectors • Increasing weight of knowledge-intensive sectors • An expanding service sector	• Unfavourable external macroeconomic conditions • Increasing regional disparities • Brain-drain • Rural regions falling behind • An increasing gap in IT use between segments of society

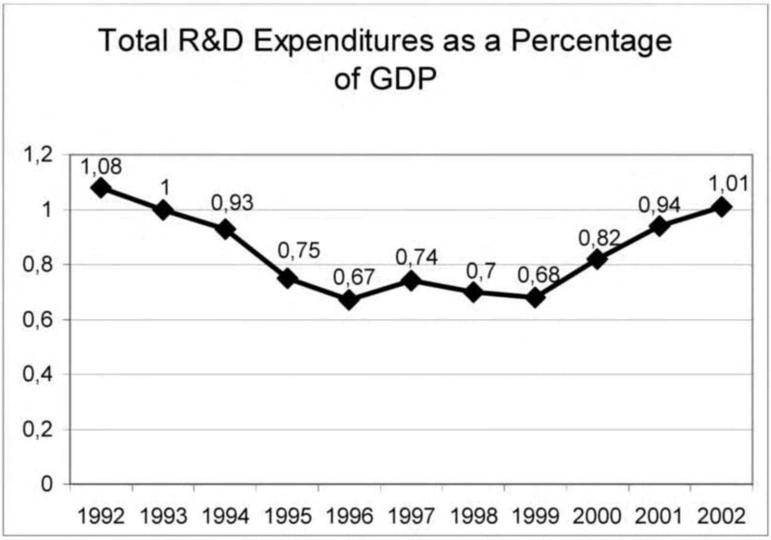
Source: Ministry of Education, Republic of Hungary

Some interesting data in the following figures and tables depicts the situation of Hungarian R&D and the innovation performance of the country.

2. Policy Approaches

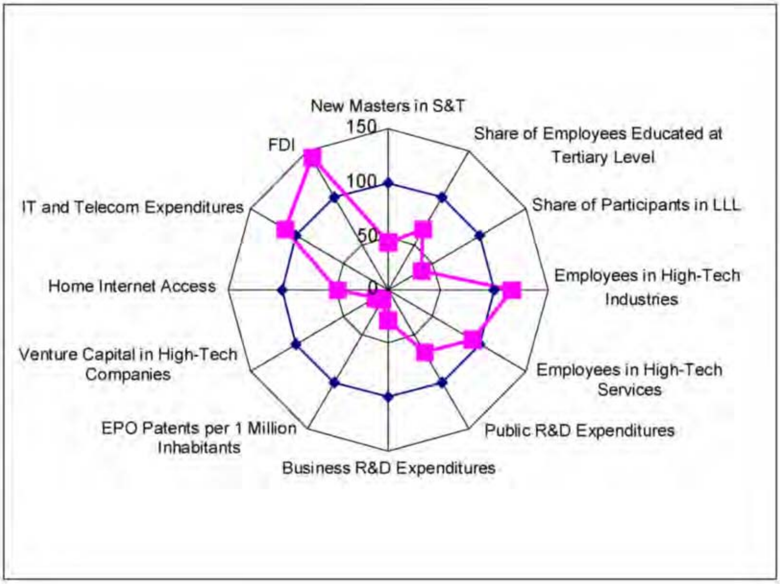
2.1. Science and Technology Policy

The fundamental principle of the science and technology policy is defined in the 2002–2006 Government Programme and in the 2002 Medium-Term Economic Policy Programme



Source: Ministry of Education, Republic of Hungary

Figure 1. Hungarian GERD/GDP Indicators in the Course of the Last Decade.



Source: Hungarian Statistical Office and [5]

Figure 2. Some Hungarian S&T Indicators Compared to the EU-15 Average.

as an important governmental tool to promote the development of the society and economy. The objective of this medium-term economic policy programme is modernisation and re-alignment with European standards, which is reflected in stronger competitiveness, striving for financial and price stability and effective cohesion between the economy and society. Production-related innovation is a priority in these programmes. Investments should be

Table 2. Principal Data of Research and Development.

Year	*Number of R&D Units*	*Calculated R&D Staff Number (Persons)*	*R&D Staff Number as Percentage of Active Earners*	*R&D Expenditure, Total (in Billions of HUF)**	*R&D Expenditure as Percentage of GDP*
1991	**1,257**	**29,397**	**0.63**	**27.1**	**1.09**
1992	**1,287**	**24,192**	**0.57**	**31.6**	**1.08**
1993	**1,380**	**22,609**	**0.58**	**35.3**	**1.00**
1994	**1,401**	**22,008**	**0.59**	**40.3**	**0.93**
1995	**1,442**	**19 585**	**0.54**	**42.3**	**0.75**
1996	**1,461**	**19,776**	**0.55**	**46.0**	**0.67**
1997	**1,679**	**20,758**	**0.57**	**63.6**	**0.74**
1998	**1,725**	**20,315**	**0.56**	**71.2**	**0.70**
1999	**1,887**	**21,329**	**0.56**	**78.2**	**0.68**
2000	**2,020**	**23,534**	**0.61**	**105.4**	**0.82**
2001	**2,333**	**22,930**	**0.59**	**140.6**	**0.94**
2002	**2,441**	**23,640**	**0.61**	**171.2**	**1.01**

**Including honoraria, salary complements of scientific degree and amounts of state scientific scholarship; excluding the costs of other activities and excluding amortisation in 1999–2001.*
Source: Hungarian Statistical Office

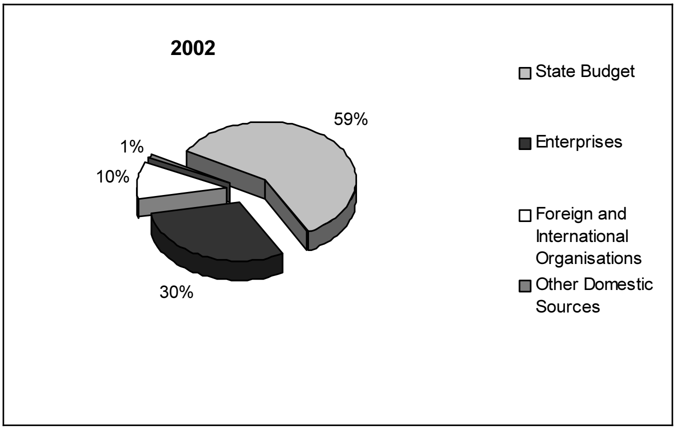
based on advanced technology, a highly skilled workforce and co-operation with local development initiatives. The government defines four priority areas [3]:

- Creating an innovation-conducive legal framework;
- Making Hungary attractive as an R&D site;
- Enhancing the protection of intellectual property;
- Increasing the sources for innovation in SMEs.

The regional co-ordination of innovation has to be strengthened to provide all regions with significantly more domestic and international sources for science and technology.

The Government Programme declares that both the state and the business community have to fulfil their roles in ensuring that the R&D sector and industry are brought closer to each other and placed in the service of the country's economic advancement. To achieve this, the country needs co-ordinated education, research, development and innovation policies, as well as measures to stimulate the research and development activities of the private sector.

On 1 May 2004, Hungary will join the European Union and will subsequently become eligible for support from EU Structural Funds and the Cohesion Fund. Member states having underdeveloped regions must elaborate and submit to the European Commission their development objectives and priorities in the framework of a National Development Plan (NDP) to get support from Structural Funds. Therefore, the National Development Plan is a national strategic document and the Government of the Republic of Hungary was responsible for its preparation coincident with the above-mentioned policy documents. The National



Source: Hungarian Statistical Office

Figure 3. R&D Expenditure by Financial Sources, 2002.

Development Plan has been elaborated while taking into account the general provisions of EU Structural Funds [4]. In addition to all this, the National Development Plan relied on Hungary's Medium-Term Economic Policy Programme. This document outlines the macro-economic framework and economic policy in which the National Development Plan has its effects and of which it is one of the implementation instruments. The Community Support Framework (CSF), representing the legal framework of support, contains the financial commitments of the EU and the Hungarian government concerning the amounts they will spend on individual jointly financed development areas between 2004 and 2006. The Hungarian NDP involves all sectors of the Hungarian economy including the R&D sphere.

2.2. Bill on Research, Development and Technology Innovation

Based on serious social and professional debates, a determined demand has emerged that all areas of R&D and innovation should be covered and regulated in one Act. The R&D Division of the Ministry of Education (MoE) is responsible for elaborating the Bill on Research, Development and Technology Innovation.

The main aim of this bill is to simplify and raise the transparency of R&D governance via clarifying the governmental tasks and responsibilities in this field. In addition, the bill is considered to aid in improving competitiveness and sustainable growth in the Hungarian economy by strengthening business-related R&D and by encouraging the use of research output.

Goals of the bill:

- To clarify governmental tasks and responsibilities;
- To promote the stability of financing;
- To accelerate the exploitation of R&D results financed from public resources;
- To strengthen innovation-policy-related information services;
- To regulate innovation-related indirect economic assistance means (taxes, capital-market tools, etc.);
- To encourage the FDI towards "high value added products-driven" sectors, and to eliminate the obstacles blocking researcher mobility;
- To create a more transparent and more consistent legal environment for R&D and innovation.

The bill is based on the usual principles of the role of government in a market economy with special respect to EU requirements and practice (support of pre-competitive activities, subsidiarity, regionality, equal opportunity, PPP, additionality, mobility, etc.). Its strategic objective is creating economic, legal and ethical standards that help increase the role of innovation in Hungary while contributing to the establishment of a knowledge-based society.

The expected advantageous impacts of the bill are the following:

- More effective and transparent structures in the field of R&D and innovation;
- Much better co-ordination between key elements of the Hungarian innovation system, improved efficiency;
- The different types of innovation clusters will be strengthened and will co-operate with each other in the regions (economic dimension);
- More effective protection of IPR (economic dimension);
- Establishment of a new Fund will eliminate the contradictions between the annual budget points of view and Exchequer management versus the financial features of long-term R&D projects (financial dimension);
- Contribution to the creation of new jobs and researcher mobility (social dimension).

The bill has to be elaborated and introduced to the Hungarian Government by the Minister of Education at the end of 2003. After governmental approval, it can be introduced to the Parliament at the beginning of the following year. According to previous plans, it will be enter into force in the course of 2004. In this context, the main planned elements of the bill are:

- Definitions (according to OECD Frascati and Oslo Manuals);
- Role of government (tasks, institutions);
- Rules of financing (programmes, transparency, accountability, calculability);
- HR in innovation (complex approach);
- Tools and institutions of regional and national innovation promotion;
- Monitoring, information services, policy-making tools;
- International R&D relations (EU and worldwide);
- Promoting public awareness of science.

3. R&D Institutional System

3.1. Restructuring the Institutional R&D System at the Governmental Level

The Science and Technology Policy Council (STPC) headed by the Hungarian Prime Minister has a crucial role in shaping the governmental science and technology policy. The deputy chairmen of the STPC are the Minister of Education and the President of the Hungarian Academy of Sciences. The members of the STPC are the Minister of Finance, the Minister of Economy and Transport, the Minister of Agriculture and Rural Development, the Minister of Informatics and Communication, the Minister of Health, Social and Family Affairs, the Minister of Environment and Water and the Chairman of the Higher Education and Research Council. The head of the National Development Office (belonging to the Office of the Prime Minister) and the Deputy Secretary of State of the R&D Division of the Ministry of Education (from January 2004 President of the National Research and Technology Office) have regularly participated in the meetings of the STPC. At the same time an advisory, evaluative and co-ordinating body, the Science Advisory Board (SAB), supports the work of the Council. The Chairman of the SAB also participates in SPTC meetings. In order to strengthen their positions, both bodies were reorganised on the basis of Governmental Resolution 1033/2003(IV.18). The Secretariat of the STPC operates in the Ministry of Education (MoE).

Recently, on the governmental level, the Ministry of Education (MoE) has been responsible for designing and implementing the Hungarian science and technology policy – for competition-based research and development programmes and for promoting the international science and technology co-operation of Hungary, including EU-related research matters.

On 1st January 2004, the National Research and Technology Office (NRTO) will be set up as a legal successor to the present R&D Division of the MoE. The NRTO will be an independent governmental office under the guidance of the Hungarian Government. On behalf of the Government, the Minister of Education will supervise the Office. A new Agency for Research Fund Management and Research Exploitation was set up in August 2003 for managing the operational tasks of different R&D support programmes financed by the new Research and Technology Innovation Fund.

The new NRTO has the following responsibilities and missions:

- It prepares documents concerning the national science and technology policy, runs technology foresight programmes, and prepares reports and reviews for promoting the acquisition and dissemination of new knowledge and information serving the government's science and technology strategy in co-operation with social partners, NGOs, and industrial and professional associations;
- It represents the government in the international field and in intergovernmental S&T organisations and programmes, and it organises and co-ordinates Hungarian participation in such programmes. In this capacity, it is also in charge of multilateral S&T co-operation and participates in the EU accession process;
- It co-ordinates the activity of the new Research and Technology Innovation Fund (RTIF) involving the former National Technology Development Fund (KMÜFA) and the National R&D Programmes, and it supervises the Agency for Research Fund Management and Research Exploitation;
- It changes the innovation attitudes of the society.

3.2. Important Research Institutions in the Public Sector

The present Hungarian national innovation system of public R&D at the institutional level consists of three main components: the Hungarian Academy of Sciences, the universities, and other public research and technology institutions [1–3].

In accordance with Act XL of 1994, the Hungarian Academy of Sciences (HAS) is an independent public body based on the principle of self-government. There are special rights and duties of the Academy:

- To support the development of the sciences, scientific research, and the publication of scientific books and journals;
- To regularly evaluate scientific research results as well as encourage and assist in the publication, dissemination and utilisation thereof;
- To represent, within its sphere of responsibilities, Hungarian science in Hungarian public life and at international scientific forums.

The HAS has 18 institutes for the natural sciences, some of which have sub-institutions comprising all fields of the natural sciences, and it has 15 institutes for the social sciences and humanities ranging from art to economics. It also has numerous research groups in all areas in the Hungarian universities. The HAS share of Hungarian research capacity in terms of the total number of other Hungarian R&D organisations is about 10%, and that of the R&D institutions within this is slightly more than 60%. The Academy's share of the total number of R&D personnel is almost 20%. With regard to the different scientific fields, this share is the highest in the natural sciences (based on the share of R&D expenditures of all R&D units, it is almost 60%), and by phases of research its share is decisive in the field of basic research (also based on the share of R&D expenditures of all R&D units, it is more than 40%). Today only 60% of the Academy's income is guaranteed from public sources (block grants); the remaining 40% has to be generated from other competitive government programmes or other sources. This has led to a shift as far as research type is concerned. Formerly described as an institution nearly exclusively doing basic research, the HAS now claims to be involved in a number of applied programmes together with industry.

The universities are increasing in importance. During the period 1998–2000, a fundamental integration process took place in the Hungarian higher education sector. The aim was to better cope with the growing number of students, to introduce more flexibility and diversity in the system, and to comply with the long-term policy objectives of the government. Therefore, the universities that were formerly compartmentalised and strongly specialised with usually rather narrow profiles of specialisation were transformed into integrated, multidisciplinary universities. This change was made in order to render it possible to increase the number of students, to broaden curricula, and to reach an intellectually critical mass for research.

In the higher education sector, the overwhelming proportion of research units is part of higher education (1421 units). The R&D budgets of universities are largely dependent on governmental subsidies. There are two main types of subsidies: normative research support and various governmental funds and programmes. Also, co-operation between the universities and the private sector and participation in multilateral and bilateral scientific programmes are the primary sources of university income.

In addition, a new Bill on Higher Education has been in progress. The main goals of this bill are integrating Hungarian higher education into the Bologna process and restructuring the educational, financial and governance system of the universities. These planned elements would have an advantageous impact on the public-private partnership between enterprises and the universities.

In this context, five Co-operative Research Centres (CRCs) began operation in 2001. The CRCs are intended to be research and engineering centres located at major universities. Their objective is to develop partnerships between institutions of higher education, other non-profit research institutions and the business sector – particularly SMEs. The MoE has set aside a special fund to support the establishment of such new centres. A centre can be granted between HUF 50 million and HUF 250 million (max. 50% of the planned budget of the centre) for an initial period of three years. Such centres will only be supported if they are established together with business partners. They should work on the basis of mutual interest, while integrating education and technology development.

There are some other public research institutions that are not under the portfolios of the MoE or the HAS, but belong instead to the portfolios of other ministries and are financed out of the budgets of these ministries. The Ministry of Agriculture and Rural Development, the Ministry of Environment and Water Management, and the Ministry of Economics and Transport have to be mentioned in this regard.

3.3. Non-Budgetary Research Establishments

The Bay Zoltán Foundation (BZF) and the Collegium Budapest are the most important among the research units of foundations and associations. The BZF is the largest research foundation in Hungary, founded in 1993 and comprising three research units: the Institute for Biotechnology, the Institute for Material Science and Technology and the Institute of Logistics and Production Engineering. Following the model of the pioneering Princeton

Institute for Advanced Studies, the Collegium Budapest (CB) is the first IAS-type institute in Central and Eastern Europe. As an adaptation of the Princeton model, the CB represents a new type of institute, different from both universities and specialised research institutes. Its main attraction is offering its research fellows temporary liberation from their administrative and teaching obligations, allowing them to concentrate fully on their chosen research agendas.

The innovation activity of the business sector is also growing more and more in importance, which is reflected in the increasing number of R&D units in enterprises. A number of well-known trans-national companies have set up research laboratories in the country, and some of the main R&D facilities in Hungary have been established or overtaken by multinational companies. Some frequently quoted examples are: *lighting equipment* – GE-Tungsram; *medical equipment* – GE-Medicor; *pharmaceuticals* – Sanofi/Chinoin, Astra, Teva/Biogal, Akzo Nobel/Organon; *information and telecommunication* – Ericsson, IBM, Compaq, Nokia, Siemens, Motorola, Tata Consultancy, T-Systems/Matáv; *machinery* – Audi, Volkswagen, TEMIC, Michelin, Knorr-Bremse, Mannesmann-Rexroth, Flextronics; *agribusiness* – Novartis/Sandoz Seeds; *household chemicals* – Unilever; *new materials* – ZOLTEK, Furukawa.

4. Measures For Strengthening RTDI

In Hungary, there exist mainly two types of governmental support for R&D and innovation: firstly, indirect economic incentives (e.g. tax or investment incentives) and secondly, direct non-refundable state support through calls for proposals. The further continuous growth of R&D expenditures will be provided by direct budget allocations and indirect economic and science policy incentives.

4.1. Act on the Research and Technology Innovation Fund (RTIF)

Before EU Membership, the financial problems of the Hungarian innovation system were put into the limelight. It was necessary to identify focus areas for Hungarian R&D because the scientific critical mass enabling the commercialisation of research results and entering specific niches of the world market can only be reached by the concentration of resources (predominantly financial resources). The ratio of enterprises inside the GERD/GDP indicator is low (see Fig. 3). On the other hand, the GBAORD/GDP (Governmental Budget Appropriations on R&D) strongly depends on the outcome of political agreement. In addition to a decline in R&D investments, publicly financed research facilities suffered major losses in the transition process [6], the condition of their equipment parks deteriorated, the supply of equipment and technical infrastructure is poor, and replacement and modernisation could take a long time. There are few spin-off companies originating from knowledge centres (universities and research institutes, for example), technology incubation is underdeveloped, seed capital is unavailable, there are no governmental orientation mechanisms channelling venture capital to innovative enterprises, and there is no effective venture capital market. Public-private partnership (PPP) is weak, and the commercial exploitation process of R&D results is insufficient.

This was the reason for elaborating a bill on RTIF introduced into the Parliament in the course of Autumn 2003. This bill was approved by the Hungarian Parliament on November 10th, 2003, and it will enter into force in January 1st, 2004.

The purpose of the RTIF is:

Table 3. The Size of the Innovation Fee as a Percentage of the Net Adjusted Revenue Paid by Companies in Hungary from January 2004.

	FY 2004	FY 2005	FY 2006	FY 2007
SME (10–50 Employees)	0.05%	0.1%	0.15%	0.2%
Large Enterprises (More than 50 Employees)	0.2%	0.25%	0.3%	0.3%

- To provide predictable and firm resources for stimulating and supporting innovation in the Hungarian economy;
- To make possible the use of domestic and international research output, the reinforcement of research and development useable in the economy and in other fields of society, and the improvement of the infrastructure and related services serving innovation.

The core resource for supporting research and development will increase in the coming years by 20–40 percent compared to 2002 figures; on the other hand, the subsidisation potential for market-oriented business research and development is expected to grow by several orders of magnitude. This will create a formidable resource for the demand-oriented research and innovation policy. At the same time, it becomes possible in higher proportion to subsidise R&D projects reaching the critical mass required for real breakthroughs in technology development and on the market.

Financial sources of the Fund:

- Payments from enterprises based on legal regulation;
- Support from the governmental R&D budget (as legal successor of the current Technological Development Programme and National Research and Development Programmes expenditures) and voluntary public interest payments from enterprises and private individuals;
- International financial sources;
- Other incomes.

Micro-size enterprises (those with less than ten employees) do not have to pay an innovation fee into the RTIF. Small companies (those with more than ten but less than fifty employees) have to pay 0.05% of their net adjusted annual revenue as an innovation fee into the RTIF in 2004. Finally, medium and large enterprises (those with more than fifty employees) have to pay 0.2% of their net adjusted annual revenue into the RTIF in 2004. The size of this contribution will increase gradually until 2007 (see Table 3).

Furthermore, companies that have been carrying out R&D activities (their own R&D or that ordered from a non-profit or public research unit or institution) can deduct their R&D costs from their innovation fee. Twenty-five percent of the RTIF should be allocated for regional innovation objectives.

The governmental budget will have to add at least the same sum of money into the RTIF as will be paid by private enterprise. The former Technological Development Programme (KMÜFA) and the National Research and Development Programmes (NRDP), which supported market-oriented applied research and technological development projects and programmes in Hungary, will be involved in the RTIF, and the Fund can be regarded as their legal successor. The financial sources of the Fund will be distributed via R&D projects and programmes. Enterprises and R&D institutes will have opportunities to receive financial assistance from the RTIF by participating in different R&D calls for proposals.

The RTIF will be a separate state fund under the guidance of the board of the RTDF-named Research and Technological Innovation Council from January 2004.

In this context, the expenditures of the RTIF are oriented towards:

- Providing financial assistance for industrial research and technological development activities;
- Promoting the creation of R&D and knowledge-intensive jobs and workplaces;
- Supporting the R&D activities of enterprises and their consortia;
- Supporting the supplementary R&D service sector (technology transfer, technology broker, PR, and bridge building organisations);
- Financing investments and projects for the implementation of a new technology culture in the domestic economy;
- Developing the R&D infrastructure in publicly financed research units;
- Facilitating Hungarian participation in international R&D projects;
- Contributing to the increasing of researcher mobility;
- Contributing to the exploitation and commercialisation of R&D results.

4.2. Promoting Hungarian Research, Development and Innovation by Structural Funds

According to data from the Hungarian Central Statistical Office, about 10% of total GERD in Hungary came from abroad in 2002. One part of this comes from the EU Sixth Framework Programme in which Hungary is participating as a full member. Hungary will join the European Union on 1 May 2004 and subsequently will become eligible for support from EU Structural Funds and the Cohesion Fund. The primary objective of these funds is to help reduce developmental disparities between member states and regions in order to strengthen economic and social cohesion. The National Development Plan has been elaborated while taking into account the general provisions of EU Structural Funds [4].

The long-term objective of the Hungarian National Development Plan (improvement of the quality-of-life) and its general objective for the given period (reduction of the significant lag in per capita income compared to the EU average) are defined on the basis of analysis. These main objectives are supported by three specific objectives: improvement of economic competitiveness, better utilisation of human resources, and promotion of a better quality environment and regional development. The National Development Plan intends to achieve these specific goals through four development priorities: a more competitive manufacturing sector, increasing employment and human resources, a better infrastructure and cleaner environment, and stronger regional and local potential. These are supplemented by the Technical Assistance priority, which assists in the implementation of the Community Support Framework. The measures defined in order to achieve the above goals are implemented in the framework of five Operational Programmes:

- The Human Resource Development Operational Programme (HRDOP) seeks to increase the rate of employment and improve the competitiveness of the workforce by providing qualifications in line with the demands of the labour market and promoting social integration.
- The Environmental Protection and Infrastructure Operational Programme (EPIOP) has set an objective to improve the environmental conditions of the country by establishing an environmental infrastructure, increasing environmental safety, and investing into nature conservation.
- The Agricultural and Rural Development Operational Programme (ARDOP) has identified the objective of making agricultural production more efficient and modern through the development of technologies for production and processing (especially food processing). The other aspect of the programme includes realignment of

rural areas and finding alternative sources of income for the rural population, development of rural infrastructure and services, and protection of rural cultural heritage.

- The Regional Development Operational Programme (RDOP) aims at the development of economically and socially underdeveloped areas, and parts of settlements within regions, by improving the economic environment and educational infrastructure that assists tourism and economic development, developing regional infrastructure, rehabilitating settlements and improving their environmental management activities, increasing regional human resources and the regional knowledge base, and modernising public administration.
- The Economic Competitiveness Operational Programme (ECOP) intends to improve the general competitiveness of the economy by supporting investments aimed at modernisation in the manufacturing sector; it will also increase social cohesion and employment through technical modernisation of small and medium-sized enterprises and support their innovation networking activities. It will promote economic innovation by supporting competitive research in the Hungarian R&D sector financed publicly and privately, as well as strengthen relations between the R&D sector and the economy.

Objectives of ECOP:

- Developing a knowledge-based economy and innovation capacities;
- Developing an economy based on technology-intensive industries and services;
- Developing small and medium-sized enterprises to reduce the dual nature of the economy.

On the basis of its objectives, the ECOP will be implemented through the following four priorities:

- Investment promotion;
- SME development;
- Research and development and innovation;
- Development of the information society and economy.

The ECOP underlines that further development of the R&D and innovation system is needed, which focuses on efficiency, quality and competitiveness requirements and thus creates the internationally competitive R&D and innovation potential necessary for economic growth as well as EU membership. Specific objectives are formulated for the R&D and innovation priorities of ECOP:

1. To stimulate co-operative research activities promoting competitiveness and sustainable growth potential;
2. To improve conditions for research, technology transfer and co-operation at non-profit and publicly financed research facilities;
3. To strengthen corporate innovation capabilities and networking in knowledge and technology transfer.

Measures and sub-measures serve for carrying into effect the above-mentioned objectives of the R&D and innovation priorities [7]:

1. Measure: support to application-oriented co-operative R&D activity.
Hungarian companies' technology deficit can be reduced, and their domestic and international competitiveness can be achieved, through research and experimental development that take place in co-operation between the corporate and science sectors. To achieve the objectives of this measure, the following sub-measure will be carried out (through a call for proposals):

- Co-operative industrial research near completion in seven scientific areas:
- Materials science, production engineering and equipment;
- Energetics;
- Transport;
- Electronics, measurement technology, control technology;
- Biotechnology;
- Environmental protection;
- Information-communication technologies and applications.

2. Measure: improvement of the conditions for research, technology transfer and co-operation at non-profit and publicly financed research facilities.
The measure will improve the supply of tools and equipment to existing research sites with public financing to develop scientific infrastructure, and it will contribute significantly to the efficiency of their R&D activities. In addition, by creating Co-operative Research Centres, the measure will also strengthen science-and-technology relations between the business and public sectors. To achieve the objectives of this measure, two sub-measures will be carried out (through a call for proposals):

- Development of the research infrastructure of non-profit and publicly financed research facilities;
- Support of partnerships and building of networks promoting technology transfer and co-operation between companies and publicly financed research facilities (Co-operative Research Centres).

3. Measure: support to the development of corporate R&D and innovation capabilities.
The measure will give assistance to innovative start-up enterprises and technology-intensive SMEs. In addition, support should be given to the establishment of new individual industrial research bases and units, to the dissemination of activities with a high added value leading to the establishment of R&D infrastructure, and to the extension of corporate R&D activities. To achieve the objectives of this measure, three sub-measures will be carried out (through a call for proposals):

- Support for the creation and initial innovation tasks of technology- and knowledge-intensive start-ups and micro-enterprises (spin-offs);
- Development of corporate research infrastructure linked to the creation of new research jobs;
- Incentives for SMEs to sub-contract R&D and acquire the right to use existing R&D results.

4.3. RTDI Tax-Related Governmental Measures

Aside from non-refundable state support through calls for proposals, the Hungarian Government has the strong intention to stimulate R&D and innovation in the private sector through indirect measures.

From January 2001, companies can account for their R&D expenditures at 200%. This option is now also available for extramural (subcontracted) R&D activity not carried out in the companies themselves. Also from January 2001 on, the amortisation (depreciation) of all R&D investments is flexible, and its rate depends on the company. From January 2003, further incentives were introduced, such as an option for tax-free investment reserves up to 500 million HUF, accelerated amortisation of R&D, ICT and machinery investments (2 years), 70% tax relief for R&D donations, etc., making innovative activities and overall entrepreneurial conditions more favourable.

In order to improve the competitiveness of domestic enterprises and create conditions for sustainable economic growth in Hungary, the Parliament decided on November 10th, 2003 that some taxation rules have to be changed.

In this context, the following additional measures will play an important role in the Hungarian technology innovation process:

- A 400% RTD tax credit if the company lab is located at a university or public research institute – from 2004;
- Tax-free employment of students up to 53,000 HUF/month (equal to the official minimum wage) – from 2004;
- Faster tax reimbursement (expediting the procedure).

5. Conclusions

Aside from the shortcomings of the innovation infrastructure and institutional system, Hungary has internationally recognised human resources that will be capable of giving the correct answer to the challenges of the globalising world economy. Hungary must set up priorities in the field of innovation and concentrate its national resources to reach the "critical" mass that is a necessary requirement for achieving a significant breakthrough concerning the improvement of the competitiveness of the domestic economy and the quality-of-life of the society.

In this context, the Hungarian Government has committed itself to launch serious reforms in the field of R&D and innovation. These actions include the governmental institutional system, financial system and the legislative environment of R&D.

Adoption of the EU regulations and recommendations in this field, as well as the new Bill on Research, Development and Technology Innovation, will create a more stable legal environment for the technology innovation process in Hungary. Both the new Research and Technology Innovation Fund and the resources of Structural Funds accessible after EU membership will contribute to strengthening the financial situation of R&D and encourage the increase of R&D expenditures in the business sector. Finally, clarified governmental responsibilities and tasks and the new National Research and Technology Office can contribute to a more effective and transparent national innovation system.

References

[1] Steering and Funding of Research Institutions: Country Report: Hungary January 2003, OECD, Paris.
[2] European Trend Chart on Innovation. Country Report: Hungary for the Period September 2002 – August 2003, EU Commission Brussels.
[3] Research and Development in Hungary 2002 (published by the Ministry of Education).
[4] National Hungarian Development Plan. Republic of Hungary, 2003.
[5] Balogh, T.: Where are We in Europe? A Comparison of Hungarian and European R&D. Hungarian Science, Vol.3, 2002, pp. 361–370.
[6] Imre, J., S&T in Hungary: Past, Present and Future. In: W. Meske et al. (eds.), Transforming Science and Technology Systems – The Endless Transition? NATO Science Series, Series 4: Science and Technology Policy – Vol.23, pp. 69–82. IOS Press, Ohmsha, 1998.
[7] Programme Complement, National Development Plan – Economic Competitiveness Operational Programme 2004–2006. Republic of Hungary, 2003.

Modernisation of Science Policy and Management Approaches in Central and South East Europe
E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

National Innovation System in Slovenia

Dr. Maja BUČAR
Centre of International Relations, Faculty of Social Studies,
University of Ljubljana, Slovenia

Abstract. The chapter introduces the institutional setting of Slovenian innovation policy, describes the current research and development system as a part of the innovation system, and presents the innovation activity of Slovenian enterprises. The selected list of measures, introduced by the government during the past ten years, is presented. Key problems in setting up a more efficient and business-friendly national innovation system are discussed. Also, most recent events in the area of national innovation policy are described and possible future activities suggested.

1. Introduction

For many Central and Eastern European countries, the transition to a market economy has been associated with a drastic reduction of research and development (R&D) funds and a slowdown in the technological restructuring of enterprises. Slovenia, on the other hand, has succeeded in avoiding the collapse of its public research sector. This can partly be attributed to the advantageous features it inherited from its previous socialist system for science and technology (S&T): a decentralised system of research institutions not organisationally linked to the academy of sciences and governmental bodies, the openness of institutes to contractual co-operation with the business sector, autonomous managerial decision-making, traditionally good links with Western research institutions, etc. [7]. Also, the government succeeded in maintaining a relatively stable public investment in R&D.

On the other hand, the start of market reforms clearly revealed the disadvantages of the inherited structures: rigid research and higher education institutions, overstaffed R&D personnel in certain research institutes of previous federal importance, overemphasised basic research compared to applied research and experimental development, an ineffective innovation system, insufficient links and mechanisms between university-based R&D, and society's socio-economic needs.

What we have seen developing over the decade of transition is relatively impressive growth of the regulatory framework for innovation and R&D policy. As shown in the chapter, Slovenia has introduced a series of mechanisms, legal documents, institutions and bodies with the task of promoting R&D and innovation. On the other hand, the relatively slow dynamics of technological restructuring or organisational changes in the economy do not yet reflect the positive contribution of this normative innovation policy. This can be confirmed by analysing the actual outcomes of different measures. Innovation policy is not yet seen as an important tool in the economy's structural transformation and as a lever of growth. Gradually, however, the attitude of policy-makers toward change and innovation and technological restructuring are being seen as increasingly important drivers of economic growth. The impact of the EU innovation policy and monitoring system (e.g. EU Innovation Scoreboard and Trend Chart Reports) has been positive in this regard as well, not only in Slovenia, but also in other new member countries.

2. Institutional Setting of Innovation Policy

The institutional framework of innovation policy has gone through several changes since independence, reflecting in part the search for the most efficient division of tasks among different ministries and in part the influence of both the science and business communities. Observing the practice in other developed countries and following the recommendations of the EU, Slovenia introduced several measures, instruments and legal documents to support innovation, entrepreneurship and technological development.[1] A brief chronological description of the institutional set-up of its innovation policy is given in the following paragraphs.

In 1994, the government of the Republic of Slovenia issued a key policy document in the area of innovation and technology development called "Technology Policy of the Republic of Slovenia". The policy document was supported by a specific program prepared by the Ministry of Science and Technology (MST) called the "Program of Support for Technological Development up to 2000". According to the Program, funds for technological development were to grow by 10% a year on average during the period 1995–2000. In the "Technology Policy" document, it was also foreseen that its practical implementation would involve several ministries in a coordinated fashion, but in reality the functioning of the policy was left to the MST and its programs [1]. The only other program indirectly supporting innovation policy was a document approved by the Ministry of Economic Affairs in 1997: "Strategy for Increasing the Competitiveness of Slovenian Industry". Some of the proposed horizontal programs directly focused on technology development and innovation. The implementation of both programs was hindered by lack of financial resources and coordination.

Initially, innovation policy was a segment of R&D policy and under the management of the Ministry of Science and Technology (MST). Within the Ministry, the people responsible for technology development and innovation fought for a more visible position, feeling that their programs were not given the same attention as those with the support of public (scientific) research. Several analyses, both national and international, called for strengthening of the technology and innovation dimension of the Ministry's focus, and eventually two separate departments were formed, both at the level of State Secretaries: one for science and the other for technology. The co-financing of industrial R&D projects, technology parks and technology centres, as well as the mobility scheme (co-financing the employment of research personnel in industry) were run via experts from the Office for Innovation and the Office for Technology. Following elections in October 2000, the new government initiated a reorganisation of the ministries. The MST was split into two segments, with the science segment going to the Ministry of Education, and the technology one to the Ministry of the Economy (ME). All of the staff and activities of the Office for Innovation and those for technology were moved to the Ministry of the Economy. This Ministry is to be the key carrier of technology development and innovation policy and support mechanisms.

One of the key new documents of the Ministry of the Economy aimed at supporting innovation and industrial R&D was adopted during 2000 under the title "Program of Measures to Support Entrepreneurship and Competitiveness 2000–2006". The program prescribes specific measures, objectives and criteria to be used to develop a national innova-

[1] This and the following chapter draw heavily on Bučar and Stare (2001), National Innovation Policy Profile: Slovenia, a case study prepared within DGXII project INNO-99-02. The study also gives more detailed information on institutional set-ups.

tion system and support enterprises, in particular small and medium-sized enterprises (SMEs), in their technological restructuring and innovation. It also served as a framework to establish and provide funding to different innovation-related institutions, like technology parks and centres, incubators, and more recently clusters and technology networks.

The Entrepreneurship and Competitiveness Department of the Ministry of the Economy is in charge of the innovation policy and technology development and of the implementation of the above programs for the period 2002–2006, but more changes are being planned with regard to organisational structure and additional activities.

In Nov. 2002, a new Law on Research and Development was adopted, under which two separate agencies are to be established within a year from the passing of the Law: the Agency for Scientific Research and the Agency for Development and Technological Research, usually called the Technology Agency by the media. The idea behind such an institutional setting is that the agencies (each in its sphere) would be responsible for a permanent, professional and independent selection process of projects and programs, which are to be financed from public resources. Each agency is to have a board of directors, a manager and a scientific (expert) council, as set forth by the Law. The government has formally established both Agencies: the Agency for Scientific Research in Nov. 2003, and the Technology Agency in February 2004; neither has begun operations yet, but they are in the process of establishing their scientific and executive boards. It is therefore expected that the new organisational scheme will have begun its work by the second half of this year.

The changes in the institutional setting of the innovation system reflect a search for the optimal allocation of tasks and instruments among different government ministries and offices. A negative consequence is that the people involved in these processes are preoccupied with the changes of the system instead of focusing more on the delivery side. An actual change in attitude towards the role of innovation and R&D has been developing at a much slower pace, with only a gradual increase in budget allocations for innovation and R&D support. One could say that while at the declaration level the Slovenian government has always been in favour of innovation policy, the awareness of the impact and of the importance of a coherent national innovation and R&D system was second (or third) only to the process of joining the EU (negotiations, legal harmonisation, macroeconomic policy adjustments, etc.) [3].

3. The Research and Development System as an Integral Part of the Innovation System

As already mentioned, Slovenia was rather successful in preserving its R&D system after its transition. Some decrease in funds was experienced only in the first years (beginning of the 1990s) due to the collapse of large industrial conglomerates. The state picked up the financing of R&D, which allowed the survival of most of the major research units. The consequence of an increased share of public funds for R&D was reorientation of academic and public research organisations in the direction of more fundamental research and looser ties with the business sector.

In recent years, business sector investment in R&D is growing and accounts for more than half of the total funds, yet little of that money finds its way into the public research sector. On the other hand, public spending on R&D focuses primarily on public research institutions and universities: in fact, business R&D receives more funds from foreign sources than from the government. This is hopefully going to change with new schemes currently under development, where preference will be given to R&D projects with business participation (even if carried out in public research institutes).

Several studies of research in business were carried out by different authors, pointing to the concentration of R&D efforts in manufacturing and further, within a selected number of

Table 1. R&D Expenditures by Financing Source, 1993–2001 (in millions of €*).

	1993	1994	1995**	1996	1997	1998	1999	2000	2001
Business	66.0	86.5	112.8	106.6	122.9	135.5	162.2	159.8	187.17
Government	101.9	121.8	125.7	104.0	86.7	104.9	106.6	121.1	129.47
Private, Non-Profit	0.2	0.3	0.2	0.8	0.5	0.1	0.2	0.1	1.24
Foreign	5.5	5.5	7.2	5.8	18.9	17.3	16.0	18.6	24.58
Total	173.7	214.11	245.9	217.2	229.0	257.8	285.0	299.6	342.42
As % of GDP	1.61	1.77	1.71	1.35	1.33	1.39	1.42	1.44	1.56

** Calculated from SIT using average annual exchange rate.*
***In 1995, the figures for R&D expenditures were overvalued due to a statistical error made in higher education.*

Source: Statistical Office of the Republic of Slovenia, Rapid Reports on R&D for consecutive years. The figures on R&D share as percentage of GDP were revised in spring 2004, due to corrections of GDP figures, and are lower than previously reported.

manufacturing branches [5]. The pharmaceutical industry remains the most important R&D performer, followed by electrical machinery, medical and precision instruments, TV and communication equipment, transport equipment, rubber industry, etc. The share of services in R&D expenditures is disproportionably low (15% in 2001), when compared to the increasing share of the service sector in value added, which amounts to 63.2% [10]. Larger businesses seem to be much more aware of the need to invest in innovation and R&D, but they have low expectations when it comes to co-operation with the public research sphere.

A critical element, which deserves more attention in innovation policy planning, is the relatively low absorption capacity of the business sector if measured by the current status of R&D units in industry. Research units in business are usually small and employ 10 engineers on average. The educational structure of researchers in the business sector is substantially weaker than that in public research units (of 2641 researchers with a Ph.D. degree, only 128 work in business sector research units). This would imply that with few exceptions, the research conducted in these units focuses primarily on development or adaptation of imported technical solutions.

Several events have recently triggered a more lively debate on R&D and innovation policy. First, the Law on R&D with its expected operational legal acts opened the question of how the two Agencies should be designed and what should be their interaction with the respective communities (science, business). Parallel to this, the Guidelines of the National Research and Development Program (NRDP) were being discussed (mostly in research and academic circles, but also in the Chamber of Economy), where a heated debate on priorities was started and is still going on.

Two different sets of priorities are being discussed: the type of research (basic vs. applied and developmental) and the scientific field (natural sciences vs. social sciences, etc.). The business sector is rather critical of public R&D as insufficiently motivated for co-operation, slow in response time, and unwilling/unable to provide the type of knowledge/technology that business needs. They argue for a changed regulative framework with a stronger focus on the economic relevance of research.

Many representatives of academia and public R&D institutes object to dramatic changes in the conditions of financing and evaluation criteria. Several arguments were made on account of basic research being of utmost importance for the survival of a nation. In the eyes of some scientists, the only approach is the provision of more money for research, with little or no attached conditions. Their focus is on science policy and little concern is given to innovation policy. Innovation for them is a matter for the business sector and has no direct link to science policy/funding. As for the reasons for low co-operation with industry, some site non-interest on behalf of industry, insufficient financial means of industry, evaluation criteria of the Ministry of Education, Science and Sports (MESS) for the programs they currently fund, etc.

This and several other policy debates revealed the inability of the two sectors to carry out constructive dialogue and a need for the government to act as mediator. At the moment, Slovenia is in a position to choose between either a vicious or vitreous circle in its R&D policy. The first option, closer to reality today, is the continuation of publicly funded research, which focuses on the science citation index and scientific excellence and having little, if any, concern for the needs of the surroundings and the growing demand for new knowledge and expertise in the business sector. Business therefore continues to rely on technology solutions from abroad and/or innovates at a much slower pace, resulting in reduced competitiveness. The consequence of lower competitiveness is lower economic growth. This, in turn, would limit the ability of the government to fund public R&D. With fewer funds available, the quality and quantity of public R&D would likely diminish.

On the other hand, a closer link with the business sector and more focus in both academic and R&D institutions on business needs could channel some of the business sector R&D investment into the public sector, which would then be able to help in a more dynamic technological restructuring. This would contribute to higher growth and revenue, for both the business and R&D sectors, as several cases in developed countries confirm. This inter-linkage is still poorly understood in science circles, at least judging from current policy discussions. Not to be underestimated are the warnings coming from successful companies who, unsatisfied with the capabilities of domestic public research, are already commissioning research abroad.

Officially, Slovenia fully adopted the EU Lisbon and Barcelona targets of increasing R&D investment to 3% of GDP. According to the planned increase of budget allocation to R&D for 2004–2005 (documents of Ministry of Education, Science and Sport talk of 24% growth) and investments planned under the co-financing scheme of EU Structural Funds[2], the goal of 1% of GDP as public R&D spending by 2010 will not be out of reach for Slovenia. More difficult will be the increase of business R&D investment to the level of 2% of GDP, even though we witnessed rather impressive growth of these investments in recent years, where Slovenia is securely on top of all new EU member countries. However, looking more closely at the sector breakdown of R&D investment, we see a high and rather constant share of a relatively small number of leading sectors, and very little change in others. Especially worrisome is the lack of interest in R&D in the service sector; trends in developed countries show a dynamic increase in the rate of R&D investment in key services (financial, business-related services, etc.), while in Slovenia most of these firms do not yet see R&D and innovation as relevant to their competitiveness.

4. Innovation Activity

According to numerous data and analyses [11], the existing level of technological and managerial capabilities in Slovenia is not yet at a level where market forces alone would be sufficient for its dynamic and integral restructuring. Slovenian enterprises are too slow in changing and innovating their production programs, techniques, products and/or services.

[2] EU Structural Funds made available to Slovenia require local participation. Priority number one under the current Single Programming Document is creation of an innovation environment, with funds available for technology parks and centres, incubators, technology networks, etc.

Table 2. Innovation Activity in Manufacturing in 1994–1996, 1997–1998 and 1999–2000.

	1994–1996	1997–1998		1999–2000	
Manufacturing (M), Services (S)	M	M	S	M	S
Share of Innovative Enterprises		33.0	11.5	28.3	13.8
Innov. Expenditure as a Share of GDP (%)	1.2	1.5	–	1.4	–
Share of Large Enterprises in Innovation Expenditure (%)	80.1	75.3	90.8	74.0	
Innovation Intensity (%)*	3.3	3.9	–	3.4	2.2

**Innovation intensity is the share of innovation expenditure in the sales revenues of an enterprise.*

Source: SURS Innovation Survey, 1998, 2000, 2003

Only 20.2% of enterprises in manufacturing and selected services have introduced innovation in the period 2001–2002. The share of small enterprises was especially low – only 12% of all small firms were innovative [16].

The recent results of the Innovation Survey (see Table 2) were not encouraging in view of innovation policy. The data (while not fully comparable with previous surveys due to a somewhat changed sample) reflect no positive trends, except for a small increase in the share of innovative enterprises in the service sector. If less than one third (and according to the most recent estimates, only a fifth) of Slovenian enterprises qualify as innovative, the transition to a knowledge-based society will not take the shape of catching up, but becoming a “second-tier” partner at best.

Can it be assessed that such behaviour of Slovenian companies is a reflection of market conditions, meaning that the current level of competition does not yet sufficiently stimulate innovation? There is some truth in this. The loss of the ex-Yugoslav market right after the declaration of independence as well as parallel changes in Eastern markets led to staff layoffs and serious cuts in production to rationalise expenses (passive restructuring). Very seldom and in a very limited scope were enterprises restored with the introduction of organisational, technological or other innovative changes (active restructuring), which could lead to increased competitiveness in the long run. This of course cannot be generalised since there are several cases of successful technological restructuring with the introduction of information-communication technologies, but not enough to dominate the scene as yet.

The government has introduced several measures over the years to promote innovation activity, yet with limited outcome. In the next section, we will introduce the most important ones and try to assess why the results are still not as positive as hoped.

5. Specific Measures to Promote Innovation Activity

From a list of different measures, which were introduced at different times to support innovation and R&D in the business sector, some of the more promising are selected. Since 1994, technology parks and centres have been important mechanisms to support cooperation for innovation. *Technology parks* are not-for-profit legal entities targeted by dynamic new companies and based on technologies or products and services, which are just starting to use the results of their research. *Technology centres* have a slightly different focus:

– R&D (for the needs of an individual branch of the economy, and also for individuals, in which case the centre must ensure the data obtained be treated with confidence);
– Aid for applying to national and foreign research and other projects;
– Performing measures and testing (with the long-term goal of becoming an accredited lab);
– Following new developments in the field of research and technology in specific areas, and informing and facilitating their introduction to individual companies;
– Performing diversified expert training for the needs of the branch.

As a rule, only one technology centre is established per each research area or branch. The financing of a technology centre is a matter of a written agreement between its founders. The sources of financing can be membership fees, state subsidies, profit from its services, municipal support, and funds obtained for national and international R&D projects. Three technology parks and 36 technology centres are currently operating. Most are eligible for government financial support.

In 2000, the Ministry of the Economy began a pilot program of cluster development. The reasoning behind the pilot program was the fact that Slovenia had no previous experience, knowledge or available instruments in the field of cluster development. The pilot program was planned for the period 2000–2003, with the aim of developing a systematic approach to cluster development, promoting the cluster concept, acquiring experience, and strengthening cluster policy. An open call for tenders was launched, out of which three pilot projects were selected: (a) Automotive, (b) Transport and Logistics, and (c) Toolmaker clusters. In 2002, a second open call for projects of cluster development was launched and 5 new clusters were formed: wood processing, plastics, information and telecommunication technologies, acclimatisation and cooling, and high-tech equipment for tourism services.

In 2002, the Ministry of the Economy started to design a separate program with the aim of developing local networks/clusters. The program was designed for small companies (up to 50 employees) within a limited geographic field.

So far, the results of Slovenia's cluster development policy from 2000 to 2002 have been encouraging: eight clusters have been established and are functioning. In 2003, clusters involve 160 companies, 43 institutions and almost 41,000 employees. There are 139 projects underway involving 586 companies and 53 research and development institutions, including the Universities of Ljubljana and Maribor [8].

One of the most successful programs (not directly focused on innovation, but more towards improving the age structure of the research community) has been The Young Researchers Program. The Program was set up in 1985 and has since worked successfully in bringing young people into careers in research. The MST/MESS evaluations over the years have shown the satisfaction on both sides; young researchers felt they would have a much more difficult task of finding employment without the program, and universities and public research organisations were able to draw more young people and assist them in getting their degrees at the same time as involving them in research projects.

The Program was extended at the end of 2002 with a special call for young researchers specifically from the business sector, since past analyses showed that after completion of the Program only a very small number of young researchers left the public-research/academic world for jobs in business. Therefore it was decided to set up a special subprogram open only to people the from business sphere, who will continue to be employed in the business sector and will already have a constant link with business during their training. The recipient of funds is the legal entity in the business sector, technology centre or regional development agency, which has an independent research and development group or has established co-operation with the research institution where the young researcher will complete his/her Ph.D. education. Since it is a new measure, it has not yet been as popular as the standard Young Researchers Program in terms of the number of applicants, but it is hoped that the interest of the business sector will gradually increase and result in the better educational structure of researchers in business.

The lack of different financing mechanisms for setting up new (especially high-tech focused or higher risk) businesses is often cited as a barrier to innovation and entrepreneurship in Slovenia. The banks have been particularly slow to respond to new business needs and very careful in placing their funds (high interest rates, restrictive clauses, no special window for new businesses). The 1999 Law on Support for Enterprises stipulated the foundation of a "risk fund for new technology-oriented enterprises", but as with most of the provisions of the Law, this was never implemented.

Subsidised interest rates are the most common way of providing support to SME's, with the subsidy coming either from special funds at the local community level or from the Public Fund of the Republic of Slovenia for Development of SMEs (JSMG). JSMG has supported over 1000 projects in the period 1996–2002, is moving gradually towards direct financing of start-up companies (13 projects financed in 2001–2002), and in 2003 also introduced a guarantee scheme and loans with a four-year grace period as a form of short-term co-ownership. The proposal of the Law on Promotion of Entrepreneurship (in the spring 2004 parliamentary procedure) is to restructure the Fund in the direction of a full-fledged venture capital fund, where public funds will be complemented with private money (current legal provisions don't allow such solution) and a more active role of the Fund is foreseen in the future. Also, one of the tasks of the new Technology Agency will be the promotion of venture capital funds.

There are several smaller venture capital funds, all private ones, the most active being Aktiva and Horizonte. According to the manager of the latter, a lack of funds is not the major issue; the quality of proposed projects is insufficient on the one hand, and on the other, several SMEs are not very keen on turning over their managerial functions to the people from the venture capital fund. They value independence more than business growth.

The Slovenian Association of Venture Capital Funds (SLEVCA) was re-initiated in 2001 by PCMG (Small Business Promotion Centre) to promote venture capital in the country, bring together different initiatives, and set up dialogue with public authorities, research institutions, universities, business associations and other relevant institutions. SLEVCA is a member of EVCA (European Venture Capital Association).

Several other measures to promote innovation have also been introduced over the years; what is missing is a continuous evaluation of these measures. Insufficiently developed monitoring of the impact of introduced measures sometimes results in their abandonment or in the introduction of new (alternative) mechanisms without a prior evaluation of the reasons for failure. This lack of continuous evaluation of policies and instruments makes it impossible to learn from one's mistakes and therefore work on improving certain mechanisms. Instead, the transfer of something (which worked in Finland or Ireland) to the Slovenian environment is practised and expected to have the same impact as in its country of origin (ideas about clusters or incubators could be examples of such). The only adjustment is a financial one: measures are expected to work in Slovenia with much smaller financial support.

6. Assessment of Slovenia's Innovation Policy

While a wide range of instruments and support measures was put in place during the transition period [4], and various institutional set-ups were tried, the impact of this activity on innovation has been limited. This opens a question of their design and implementation. Major difficulties pertain to non-securing of sufficient funds even for approved government initiatives and programs aimed at supporting innovation, to non-transparency in the allocation of funds, and to poor coordination among different governmental bodies regarding the funds/mechanisms. Sometimes it seems there is more interest in the number of instruments (the more, the better) than in their actual efficacy. This leads to insufficient financial and human resources devoted to the implementation of the measure/ instrument.

Currently, there are several positive indices in Slovenian innovation policy. Besides the already mentioned changes in organisational set-up, Slovenia has made the creation of an innovation-supportive environment the top priority in the Single Programming Document, prepared for the channelling of EU Structural funds. Several activities will be supported, focusing on creation of technology networks, research and development co-operation, innovation training, etc. The SPD needs to be negotiated with the EU Commission on the one hand, and on the other, since it requires local financial participation, budgetary provisions for 2004 need to be made for local shares in each proposed activity. To succeed in placing innovation so high on the priority list was a major achievement of the ME and is a reflection of the gradual change in attitude towards innovation in overall government policy. Yet one of the key problems with Slovenian innovation policy so far has been the gap between declaration and implementation [4], and one can only hope that this will not repeat itself with the SPD.

The ongoing discussions and policy debates reflect a growing awareness of the importance of a coherent national innovation policy for further economic growth and competitiveness. Yet on the other hand, several indicators show that the gap between policy and actual practice remains wide. The stakeholders, especially within the science community, still poorly understand some of the key characteristics of an innovation system in a knowledge-based economy. Arguments in favour of the status quo are still made by people of significant authority in the public R&D sector. The centrality of innovation policy is not yet an accepted concept among those who design economic policy at the national level.

Business sector R&D expenditures reflect a high degree of concentration in only a very few industrial branches and can be assigned to a small number of individual large companies active in a limited number of industries; these few companies are all export oriented and therefore facing global competition. So it would be premature to conclude that the rising business expenditures on R&D reflect a positive outcome of the macroeconomic policies of an open market economy, since the majority of these companies were in the forefront of R&D and innovation investments in the past as well. The INNO study [9] provides a broader insight, finding a dual picture in all candidate countries, where "a few firms are heavily investing in innovation activities, while the overwhelming majority of other companies, especially SMEs, are not undertaking innovation." This duality is especially worrisome since a supposed policy focus of transition countries during the last decade was the promotion of SMEs and at least in terms of the number of new enterprises created the goal was achieved in all observed countries. What it signals (at the same time requiring a more detailed analysis) is that new enterprises are not innovative enough and are seldom the result of entrepreneurial efforts to turn invention into innovation.

The raising of awareness is one of the areas of innovation policy that should be given more systematic attention. While several different activities in the field of R&D and innovation have taken place, there is no centrifugal force bringing the efforts of different institutions or individuals into a common framework. This can be singled out as one of the key deficiencies of Slovenian innovation policy. In principle, the need to raise public awareness of the importance of innovation policy was considered important by the government, but the fact remains that few coordinated activities have been organised in this regard.

One such continuous activity is the annual conference on innovation and entrepreneurship, organised by the Faculty of Economics and Business at the University of Maribor (known under the acronym PODIM). The organisers try to combine contributions from academia with the practical experience of people in enterprises, incubators, technology centres and regional development agencies.

The Slovenian Science Foundation is another institution devoted to raising public awareness, especially among youngsters. With its annual Science Festival, it tries to draw attention to the results of Slovenian science. Over the years, this has been the main instrument in popularising scientific developments in Slovenia. Government support has oscillated significantly from year to year, however, making it difficult to plan any expansion of activity.

Especially lacking is the raising of awareness among the general public, since at most events "the convinced are convincing themselves" [2]. Putting innovation and entrepreneurship at the forefront of economic development policy calls for a significant increase in awareness-raising activities related to the importance of innovation and entrepreneurship as two of the main factors of growth and competitiveness. This is needed both within the government and the business community as well as within the general public, since innovativeness is an important value characteristic of an individual society. Currently, Slovenes are not very entrepreneurial, risk-taking or innovative, so a holistic innovation policy would also have to address these issues.

References

[1] Bavec, Cene (1998). O vlogi Ministrstva za znanost in tehnologijo v tehnološkem razvoju (On the Role of the Ministry of Science and Technology in Technological Development). Raziskovalec, 28(3): 64–65.
[2] Bučar, Maja (2003). Innovation Performance, SMEs and Candidate Countries – Some Comments from Slovenia, background paper for Conference on Implementation of the European Charter for SMEs in the CCs, Tallinn, Oct.1, 2003.
[3] Bučar, Maja and Stare, Metka (2003). Inovacisjka politika male tranzicijske države (Innovation Policy of Small Transition Countries). Ljubljana: Faculty of Social Science.
[4] Bučar, Maja and Stare, Metka (2002). Slovenian Innovation Policy: Underexploited Potential for Growth. Journal of International Relations and Development, 5(4): 427–448.
[5] Bučar, Maja (2002). Družbenoekonomska vpetost raziskovalne dejavnosti (Socio-Economic Relevance of Research Activity). In: S. Sorčan (ed.), Raziskovalna dejavnost na Slovenskem v 90.letih dvajsetega stoletja (Research in Slovenia During the Nineties), 135–154. Ljubljana: Slovenska akademija znanosti in umetnosti.
[6] Bučar, Maja and Stare, Metka (2001). National Innovation Policy Profile: Slovenia. Innovation Policy in Six Applicant Countries: The Challenges, INNO-99-02, ADE. ftp://ftp.cordis.lu/pub/innovation-policy/studies/studies_six_candidate_countries_slovenia_2001.pdf
[7] Bučar, Maja and Stanovnik, Peter (1999). Some Implications for the Science and Technology System in a Transition Economy: the Case of Slovenia. In: Brundenius et al. (eds.), Reconstruction or Destruction? S&T at Stake in Transition Economies. Hyderabad: Universities Press (India) Ltd.
[8] European Commission (2003). Trend Chart Report on Slovenia, Oct. 2003. (http://trendchart.cordis.lu/Reports/index).
[9] European Commission (2001). Innovation Policy Issues in Six Candidate Countries: The Challenges. Directorate General for Enterprise. ftp://ftp.cordis.lu/pub/innovation-policy/
[10] IMAD (2004). Spring Report.
[11] Ministry of the Economy (2000). Programme of Support to Business Enterprises in the Development of New Technologies and Establishment and Operation of Their R&D Units 2000, mimeo.
[12] SURS (2000). Statistične informacije (Statistical Information), Raziskovanje in razvoj, znanost in tehnologija (R&D, Science and Technology), no. 81 and no. 96.
[13] SURS (2002). Statistične informacije, Raziskovanje in razvoj, znanost in tehnologija, no. 182.
[14] SURS (2003). Statistične informacije, Raziskovanje in razvoj, znanost in tehnologija, no. 307.
[15] SURS (2004). Data on R&D, mimeo.
[16] SURS (2004). First Release on Innovation Activity, no. 38.
[17] SURS Innovation Survey, 1998, 2000, 2003.

E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 14

Regional Technology and Innovation Policy

Dr. Guenter H. WALTER
University of Karlsruhe, Centre for Cultural and General Studies, Germany

Abstract. The activities of regional technology and innovation policy mainly refer to stakeholders in a region with potential in innovation. Regional innovation capability is strengthened by the formation of co-operative approaches, and service institutions are formed for mediating co-operation. Also, public bodies are integrated in networks. Regional technology and innovation policy is an approach for regional development in innovation and technology and combines regional capabilities in a complementary way according to their strengths and constraints. In this way, quantitatively significant positive economic and social effects are achieved and confidence in the region's competence to solve problems is created. Due to the "globality" of new technologies, better access to international and national technology programmes is also provided by regional synergies. This is necessary for regions to engage in interregional and global co-operation.

1. Introduction

Innovation and technology policy is a policy that concentrates primarily on techno-scientific issues [7]. It assists the initiation and expansion of innovation and helps to create an appropriate societal framework to ensure the good performance of research, technology and development (RTD). Innovation and technology policy consciously attempts to influence the development of technology towards an orientation that will secure the innovative capability of an economy, in order to ensure its competitiveness.

Justification [1] of innovation and technology policy is grounded, among other things, in the duty of the state to remove supply deficits in information and financing, and to make public and publicly financed commodities such as research institutes available to everybody that needs them. Innovation and technology policy can also provide support for the co-operation of stakeholders in co-ordination with other relevant public innovation measures. Practically every developed state and region has implemented such policies.

In industrial countries, a sophisticated, self-complementary bundle of measures of technology and innovation policy exists for the institutional promotion of RTD and for the support of academic research and the generation of new ("high-tech") technologies [7]. The broad, rapid application of new ways of production and production processes is also promoted, as are product innovations. The most important instruments of innovation and technology policy are 'direct' financial incentives granted to research institutes and enterprises. These kinds of support programmes are usually found on the national or international level.

If only limited financial means are available, innovation and technology policy mainly tries to exploit existing advantages. By providing information, consultancy, training and co-operation [9], this type of promotion makes use of features specific to smaller areas, such as advantages of proximity, homogeneities, regional particularities, and collective learning processes; it is not primarily directed towards the generating of new technologies, but rather towards increasing the diffusion and utilisation of already available technologies. Regional Technology and Innovation Policy (RTIP) – necessarily – makes very selective use of public (promotion) funding that can only be given to specific groups of stakeholders and for specific occasions (e.g. for the kick-off financing of innovation and technology-based services). Because RTIP is limited in the scope of its fields of action, it needs to find its own role and orientation through its adaptability and openness to national and global needs.

The division of tasks between the region (as the initiator of RTIP), national authorities and international organisations is clearly defined (e.g. technology transfer, promotion of small enterprises, innovation-supportive services performed in the region, development of "high-tech" technologies, academic research, nationally and internationally relevant approaches performed by national authorities and international organisations).

2. Regional Technology and Innovation Policy

The purpose of RTIP is to achieve an intra-regional network of regional stakeholders in business, science and public policy. Intra-regional networking leads to co-operation:

- In industry and commerce, e.g. between large and small enterprises: small and medium enterprises (SMEs) as suppliers, mutual interchange of product ideas, co-operation of SMEs for the realisation of extensive innovations, etc.;
- Between firms and research and development (R&D) institutes and education institutions: R&D as a 'pre-thinker' and problem-solver for industry, training of skilled younger-generation personnel, etc.;
- Between commerce/industry and public policy/administration.

The elements of RTIP are the support of:

- A strong intra-regional network of enterprises (particularly the possibility for co-operation);
- The creation of skilled employment and possibilities to found firms;
- Training and further qualification in order to qualify enterprises for innovation;
- Activities to focus regional universities and R&D institutes more strongly towards the needs of regional enterprises;
- The formation and enlargement of an innovation-oriented infrastructure, e.g. advisory institutions, agencies and technology centres offering innovation management and innovation training, incubator centres, industrial parks and supportive foundations;
- Financial and other assistance in the mobilisation of innovation capital (endowment funds);
- The formation of a consensual regional view of problems and development strategies and visions.

RTIP is intended to induce previously non-innovative enterprises to become innovative, to encourage already-innovative firms to expand and intensify their innovative activities and to ensure that there is always a sufficient number of new and technology-based regional firm foundations. RTIP especially contributes not only politically but also generally to improving the societal framework, which will attract enterprises, research institutions and experts to locate themselves in the region.

Another goal of RTIP is to integrate the region into international technology development. Therefore, RTIP measures are adapting existing and planned future activities in the region to international standards and qualifying regional enterprises and research institutes for participation in international programmes. Also, RTIP efforts are being made in the global exchange of information. RTIP supports defined regional interfaces with global and supra-regional networks and includes neighbouring regions, or regions with a similar structure, in its strategic considerations.

The technological contents of RTIP are strongly dependent on general and global technological development, as single regions can hardly exert any influence on this development. In this context, therefore, the availability of information on, and capital for, global technology development needs to be secured and appropriate information procurement measures need to be supported.

RTIP consists of indirect and informal measures with the aim of achieving good economic regional performance through the exploitation of endogenous resources and the supra-regional integration of the region. Because of its low cost, RTIP can be based on instruments that are made available to a large number of firms (e.g. the majority of firms, or all firms in a region or branch). As RTIP support of firms usually cannot be financial (at least not to any great extent), RTIP provides assistance through appropriate financial institutions integrated into the network.

Thus RTIP has to foster the set-up of institutions, or the fields of activity of existing institutions have to be expanded and modified appropriately. RTIP is thus a demand-oriented, "bottom-up" approach. Since RTIP steering possibilities are much more restricted than large national and international programmes, performers of RTIP are only moderators between different interest groups. In this type of function, personal contacts and advantages of proximity are important. Geographical closeness and proximity advantages make RTIP function by creating numerous feedback loops between the stakeholders.

3. Regional Target Groups of RTIP

Because RTIP is limited in the scope of its fields of action, its derivation is especially directed towards regional stakeholders that can act as engines for innovative economic development. Service institutions supported by RTIP offer publicly subsidised services to specific groups that are found to be regionally important by RTIP-makers. If these groups are not in a position to bear all the costs of such services themselves, RTIP may provide (partial) public funding, but in the longer term clients should be prepared and able to pay.

RTIP measures consist of improvements in regional possibilities. By providing infrastructure in service, this could involve modernising and innovatively rationalising the business organisation (production and sales), e.g. quality assurance, production innovation and automation of enterprises that are present in the region. Another idea is to improve regional recruitment of personnel (technical specialists, management personnel), provided the appropriate prerequisites in training and further qualification are available or created by RTIP. Other strategies that appear feasible are co-operative exploitation of firms' experiences, such as transfer of product ideas, firms taking on international and trans-national sales tasks for each other, and the support of spin-offs.

If there are deficits in technical competence and a lack of business management and commercial knowledge of manufacturing firms in economic sectors, co-operation with qualified service institutions – possibly partially publicly financed – could help with this problem cluster. Small firms in the production sector are especially of interest as a target group for RTIP measures because they are usually numerous.

Young high-tech enterprises are a specific target group for RTIP as a source of dynamic regional growth and employment. Usually they close gaps in the exploitation of knowledge. Their R&D productivity is very high, as is their willingness to take risks. They are characterised by great flexibility and a strong demand orientation. Impeding factors in the growth of these firms relate to financing, innovation management and the challenges of planning and business organisation that are associated with the growth of an enterprise. Often there is a barrier associated with the mobilisation of potential firm founders, particularly from the field of research, who can contribute to turning technological developments into marketable products. RTIP needs to concern itself with the qualification of potential firm founders, and it also needs to participate – through studies, consultancy and services – in creating a suitable environment to stimulate firm foundations.

Also, RTIP tries to ensure the orientation of regional universities and R&D institutes towards regional needs, so that they educate more students and scientists in the fields required by the regional economy. Here, RTIP can mediate traineeships in firms, etc. Usually the specifically targeted training and further qualification of expert personnel and specialists in technology and innovation management fields also needs expanding. Publicly supported research institutions should be able to carry out assignments (R&D, tests, equipment loans, etc.) for regional businesses. RTIP may use appropriate incentives, research institutions to seek R&D co-operation with enterprises, thus contributing to the transfer of technology from science to application.

4. Objectives and Measures of RTIP

RTIP can primarily rest only on existing economic and scientific resources and on their combination. As many stakeholders as possible should be involved in networking. Co-operation between industrial firms, between production and service sector firms, and the involvement of various research institutions in RTIP are seen as important prerequisites for innovative regional development. As all relevant stakeholders in business, science and public policy should have a common point of view of the situation of the region and its future needs, RTIP supports the elaboration of a consensual regional view of problems and visions and ways to develop regional strategies.

4.1. Elaboration of Visions

The nature of individual thought and action, lifestyle and working style, existing status of training and education of the (working) population, “entrepreneurial spirit”, and institutional modes of behaviour – in other words, the cultural framework – are important factors that exert an influence on innovation at the regional level. Thus access to know-how, readiness, ability and familiarity in handling skills are important for innovative capability. The vision should take into consideration the possibility of transforming a “regional culture” into a “regional technology”. Such a vision generally ensures a positive public opinion of innovation. Measures to achieve these goals would be the implementation of a media mix in public relations, regional conferences, round-table discussions, implementation of regulations, etc. organised by RTIP-makers. Well-qualified public bodies efficiently placed within regional networks can present visions and development strategies to the general public and gain a high degree of acceptance for necessary changes.

4.2. Mobilising Endogenous Resources

RTIP must encourage firms that have not been innovative so far to engage in relevant activities, by attempting to positively influence the interactions of objective and informal mechanisms in commercial and technological activities. Sufficient availability of information and knowledge provided by RTIP-supported innovation consultancy institutions for regional enterprises [6] can create an awareness of innovation among the firm's decision-makers, thus clarifying the risks associated with innovation and making the firm able to deal with them.

Already present and innovative enterprises can be motivated to enlarge or strengthen their innovative efforts through the provision of R&D and innovation funding (e.g. by venture capital). For RTIP-makers there may be a necessity for the setting up (or specialisation) of regional institutions (such as funds) in order to mobilise capital for innovation financing.

SME support is especially important in this way, so that these firms have the chance to fulfil specific tasks, such as being market suppliers of small but important innovations (at their own market responsibility) or acting as innovative suppliers of larger enterprises (if they are able to meet the required standards of suitable products). Within a network of participating large and small firms, small innovative companies could even become the creators of new product ideas for larger firms, especially if these firms are in the process of diversification.

To foster dynamic regional developments, it is often necessary to increase innovation potential by stimulating the founding of technology-based firms and other fast-growing companies. RTIP cannot support these activities by mounting expensive financial programmes combined with techno-economic consultancy, but it can promote the creation of regulatory conditions for industrial and other regional establishments, which will help to support – both formally and informally – the firm founding activities of employees of these institutions wishing to found their own firm. This might consist in paid or unpaid leave, an agreed guarantee of re-employment in case of failure of the new enterprise, and the right to make use of certain results of the "mother institution" either free of charge or at a low cost. RTIP-supported service institutions may play an important mediating role in doing so.

Besides stimulating new firm foundations and motivating firms to innovate, the way for RTIP to attract innovative, mobile firms, institutions and also experts from other areas to the region, is by improving regional conditions for innovation and particularly innovation-supportive services. This means equipping the region with relevant R&D institutions, e.g. by enlarging the fields of activities of existing entities. Another way of improving innovation conditions is to increase the opportunities for contacts and exchanges with R&D institutions through the transfer of personnel, and by creating opportunities for businesses to make use of scientific apparatus and equipment at low cost. Additional strategies of RTIP that can be used are the specialisation of "classic" industrial promotion measures – such as the provision of industrial sites – by tying them to priority fields or co-ordinating them according to specific local advantages, and by providing a favourable societal framework.

4.3. International Integration and Networking

The aspect of RTIP that particularly concerns the international exchange of information and communication is to support the creation of contacts and co-operation with institutions outside the region. Besides specialised service institutes such as advisory and information centres and industrial associations, RTIP could also contribute to networks integrating exporting firms and R&D institutes with international partners.

Besides the acquisition of information, another necessity is the raising of funds from outside the region for innovation financing. This is possible through the judicious participation of existing institutions, e.g. with new financing options. By integrating existing expertise into funds or capital societies and thus providing residual financing for national or international support programmes, the regions could be enabled to participate more intensively in international programmes.

Another form of international and global activity is international co-operation projects. In order to participate in these, regions have to make their knowledge and experience available, also internationally, possibly via specific service enterprises, newly created by RTIP. This aspect is important, since an innovative region also has to make substantial contributions of its own in international co-operation, if it is to be recognised as an equal partner in the global exchange of information and capital.

As a result of a successful RTIP, relevant innovative regional capacities co-operate closely, according to their capabilities. A precondition for achieving these developments is to integrate different institutions so that networks are able to provide the necessary services of consultancy, moderation, co-ordination and financing. RTIP supports the foundation and kick-off of co-ordinating institutions for such networks, but in the long term, clients must be able to cover these costs at least partially themselves.

5. Outlook

RTIP activities mainly refer to stakeholders in the region with employment, turnover, export, innovation (personnel and financial means) and co-operation potential, as well as new (technology-based) firms. In this way, quantitatively significant positive economic and social effects are to be achieved through RTIP by a very specific form of 'low budget' policy.

RTIP-strengthened firms' innovation capability through the formation of co-operative approaches as qualified service institutions could be formed for mediating co-operation. Also, regional synergies provide better access to international and national technology programmes. Due to the "globality" of new technologies, this is necessary for regions to engage in interregional and global co-operation with other regions specialising in similar or complementary fields.

Public bodies integrated in networks are demand oriented, efficiently placed and qualified to represent their work to the general public and gain a high degree of acceptance for regional developments and visions.

RTIP combines regional capabilities in a complementary way according to their strengths and constraints, and it creates confidence in the region's competence to solve problems.

References

[1] Ewers, H. J.: Marktversagen und Politikversagen als Legitimation staatlicher Forschungs- und Technologiepolitik. In: Krupp, H. (ed.): Technologiepolitik angesichts der Umweltkatastrophe. Heidelberg, 1990.
[2] Industrie- und Handelskammer Karlsruhe (ed.): Die Technologie Region. Karlsruhe, 2004.
[3] Kirchhoff, U. and Mueller-Godeffrey, H.: Lokale Wirtschafts- und Innovationsfoerderung. Stuttgart, 1991.
[4] Koschatzky, K.: Raeumliche Aspekte im Innovationsprozess. Muenster/Hamburg/London, 2001.
[5] Leder, M. and Seeck, G.: TechnologieRegion Karlsruhe. In: Dialogue: 10 Elements of our Identity. Karlsruhe, n.Y.

[6] Meyer-Krahmer, F., Dittschar-Bischoff, R., Gundrum, U., Kuntze, U., Gielow, G., Krist, H., and Walter, G. H.: Erfassung regionaler Innovationsdefizite. In: Schriftenreihe des Bundesministeriums für Raumordnung, Bauwesen und Staedtebau, Heft 06.954. Bonn, 1984.
[7] Meyer- Krahmer, F. and Kuntze, U.: Bestandsaufnahme der Forschungs- und Technologiepolitik. In: Grimmer, K., Haeusler, J., Kuhlmann, S., and Simonis, G. (eds.): Politische Techniksteuerung – Stand der Forschung. Opladen, 1992.
[8] Pfirrmann, O. and Walter, G. H. (ed.): Small Firms and Entrepreneurship in Central and Eastern Europe. Heidelberg, 2002.
[9] Reger, G. and Kuhlmann, S.: European Technology Policy in Germany. Heidelberg, 1995.
[10] Steiner, M., Jud, T., Poeschl, A.; Sturn, D., Gundrum, U., and Walter, G. H.: Technologiepolitisches Konzept Steiermark. Graz, 1996.
[11] Steiner, M. (ed.): From Old Industries to New Regions – Policies for Structural Transformation in Accession Countries. Graz, 2003.
[12] Walter, G. H.: Resource-Adaptive Technology Policy for Central and Eastern Europe. Seminar "Best Practices to Strengthen the Capacity of Research and Technology Organisation to Facilitate the Development of SMEs", 13–16 October, mimeo. Warsaw, 1998.

This page intentionally left blank

PART III

Management in Science, Peer Review and Lobbying for R&D

This page intentionally left blank

Modernisation of Science Policy and Management Approaches in Central and South East Europe
E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 15

Human Resources Management for Improvement of R&D Competitiveness

Dr. Miloš KOMAC and Marjana BERTONCELJ
Ministry of Education, Science and Sport, Ljubljana, Slovenia

Abstract. The paper describes the Young Researchers Programme, which has been running in Slovenia since 1985. The aims were to renew and rejuvenate research and teaching personnel in universities and research institutes, to educate highly skilled personnel for employment in the business sector, and to promote postgraduate education and training in Slovenia in general. So far, around 5000 postgraduates have been included into the programme, and around 2800 have finished by obtaining a Ph.D. or M.Sc. degree.

Introduction

Being aware of the importance of permanent improvement of human potential in academic research establishments as well as that of a highly educated and skilled workforce in industrial R&D departments for increasing competitiveness on international markets, Slovenia launched the "2000 Young Researchers Programme" in 1985. It was initiated by the government's Committee for Research and Technology and the Slovenian Academy of Sciences and Arts, and was made operational by the funding agency for research and development (Research Community of Slovenia). The aims were to renew and to rejuvenate research personnel in research institutes and research and teaching personnel in universities, to educate highly skilled personnel for employment in the business sector, and to promote postgraduate education and training in general.

1. Evolution of the Young Researchers Programme

Early participants in the programme were expected to undergo training and education for a period of a few months to up to 6 years. It was anticipated that approximately 200 university graduates per year would be sourced from the faculties, while 280–380 persons annually would attended informal training. In fact, around 500 graduates were engaged annually in the first years. A clear drop in available positions was seen in 1992. The reason was a significant reduction in funds allocated to the programme; the declining trend continued up until 1994. Since 1995, the Ministry of Science and Technology again gradually increased the level of financing, which resulted in stabilizing the number of new positions at around 250 per year. Thus at the moment, approximately 1000 postgraduate posts are financed. In total, around 5000 young researchers were included into the programme since 1985, and 3300 have finished their studies until now. Of these, 15% finished their training with informal education or specialisation, 40% with M.Sc. degree and 45% with Ph.D. degree. Gender distribution is rather equal.

2. General Information

2.1. Important Criteria for Admittance of Young Researchers in Training Programmes

Young researchers:

- Average study grade at least 8 at level II;
- As a rule, age up to 28;
- Slovenian citizens or Slovenians without Slovenian citizenship, eligible for education in Slovenia under the same conditions as Slovenian citizens;
- Foreign citizens, eligible for education in Slovenia under the same conditions as Slovenian citizens.

Research mentor:

- Is a Ph.D.;
- Can show internationally comparable results in scientific research;
- Has ability for organisation and leadership.

2.2. Characteristics and Advantages

- The young researcher is employed by the organisation where training takes place for a set time period;
- He/she works on applied projects parallel to postgraduate studies;
- Funding of research work and cost-covering of postgraduate studies is guaranteed,
- Rights, obligations and responsibilities of young researchers are defined by the Collective Agreement for the Research Sector, which provides equal terms for all young researchers regardless of the organisation of employment;
- In the event that the young researcher concludes training with the achieved formal education degree early, he/she is financially stimulated;
- There is a possibility to undergo training abroad, at least partly;
- In exceptional cases, complete Ph.D. studies abroad are permitted.

2.3. Funding Period

- 4.5 years for uniform Ph.D. studies;
- 2.5 years for M.Sc. studies;
- There are special provisions for postgraduate studies in medicine.

3. Evaluation of the Young Researchers Programme

The launching of the Young Researchers Programme was a strategic decision, based on the evaluation of Slovenia's R&D sector in in the mid-eighties. In general, the goals were achieved. The figure of "2000 Young Researchers" was substantially exceeded, the age structure of human research potential in Slovenia improved, and a strong base of junior researchers was established. The failure rate was acceptably low, and brain drain during the period can be estimated as negligible. However, considering the further employment of young researchers, only a few – especially those with Ph.D. degrees – entered industrial R&D departments. In total, about 60% remained in academic research institutions (75% of all Ph.D.s), about 20% joined the business sector (10% of all Ph.D.s), and a similar number continued their careers in public administration (15% of all Ph.D.s). The low interest in industrial careers could be explained by the transition to a market economy in the nineties, which caused many industrial enterprises to undergo restructuring, downsizing, or even bankruptcy. This seriously diminished or even eliminated opportunities for industrial research. On the other side, an increasing number of rather well paid job opportunities in public administration – especially in ministries in charge of education, science, technology, and environment – attracted postgraduates who were not especially interested in continuing research careers.

In its effort to revitalise industrial research, the Ministry of Science and Technology started a new postgraduate programme as early as 1993 in which business enterprises could apply for grants for young researchers in their research establishments, provided the candidates fulfilled general conditions (e.g. age, average mark of undergraduate studies, etc.). However, due to the situation in the nineties as described above, the scheme was estimated as unsuccessful, and was therefore abandoned.

In the year 2001, there emerged a new, strong interest in the re-establishment of the scheme mentioned above, this time jointly with the Ministry of Economy. Around 30 positions are offered annually. The statistics show that the candidates come from companies belonging to a large variety of sectors and sizes.

4. Lessons For the Future

In spite of the undoubted success of the programme, its future evolution should take into consideration its own experiences as well as practise and experiences from abroad. Above all, the recruitment of future scientists starts as early as primary education.

4.1. Interest in Science Throughout Primary and Secondary Education

- Science teaching must have a pivotal role in early stages of education;
- Curricula must be attractive in order to avoid the boring nature of science teaching;
- Informal education – institutions like science centres and events like science weeks or science competitions – is an important player in promoting science among young people;
- Media, especially TV, are leading sources of information.

4.2. Undergraduate Education

- The attractiveness of chemistry, mathematics, physics and some areas of engineering is decreasing, resulting in the decreased quality and number of undergraduates;
- The attractiveness of life sciences and computer sciences is increasing;
- Threat: drop in quality and number of science and engineering undergraduates;
- Threat: the present production of Ph.D.s in the EU is not sufficient for achievement of the goals of the Lisbon declaration;
- Measures: improve financing and working conditions, e.g. research infrastructure and quality of supervisors;

- Introduce measures in postgraduate education and training that enhance the employability of Ph.D.s.

4.3. Career Progression

- Career system of academic researchers: fellowships, short term contracts, tenure tracks, permanent employment;
- In general – lack of stable long term employment prospects for careers in academia;
- Many graduates at the Ph.D. level do not continue an academic research career and even enter jobs which are not connected to research;
- Little attention is paid to the mid- to late-career development of research scientists.

4.4. Investments Affecting Human Resources Development for R&D

- Investments in the educational sector;
- Investments in R&D infrastructure;
- Investments in specific research projects;
- Investments in work, environmental and social conditions;
- Investments life-long-learning and training;
- Investments in the increased awareness and promotion of science.

5. Conclusions

Human resources management for R&D is a long and demanding process. An interest in science and research among youngsters has to be carefully nourished, beginning in the early stages of education and then throughout the further education steps. Undergraduate education creates the main recruitment pool for scientists and engineers, hence the declining number of science and engineering students is potentially a serious threat to national R&D competitiveness. It is up to the government to create an environment that stimulates a career in research along the active life path.

References

[1] Research and Development Activities Act, Official Gazette of the RS, No. 96/2002.
[2] Rules on Training and the Inclusion of Young Researchers in Research and Higher Education Organisations, Official Gazette of the RS, No. 48/2002 and 36/2004.
[3] Rules on Training and the Inclusion of Young Researchers in the Business Sector, Official Gazette of the RS, no. 66/2002 and no. 48/2004.
[4] Benchmarking National R&D Policies, STRATA-ETAN Expert Working Group "Human Resources in RTD", Final Report, August 2002.
[5] Researchers in the European Research Area: One Profession, Multiple Careers, COM (2003) 436 Final, July 2003.
[6] Towards a New Paradigm for Education, Training, and Career Paths in the Natural Sciences, ESF Policy Briefing, No. 16, July 2002.
[7] Agents for Change – Bringing Industry and Academia Together to Develop Career Opportunities for Young Researchers, ESF Policy Briefing, No. 17, July 2002.

Modernisation of Science Policy and Management Approaches in Central and South East Europe
E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 16

Management of Quality and Finances in Research on the National Level

Dr. Janez SLAK, Dr. Miloš KOMAC, Dr. Nada ŠVOB-ĐOKIĆ,
Dr. Slavo RADOSEVIC and Dr. Edvard KOBAL

Abstract. Efficient management of quality and finances in research places a great demand on people participating in the implementation of national research programmes. This is especially true for higher administrators working at the ministries responsible for science, as well as at other important state agencies that manage public funds for science.

This article presents the main findings of the participants of the NATO Advanced Training Course (ATC) "Modernisation of Science Policy and Management Approaches in Central and South East Europe". They were developed by working groups and present a direct contribution of the NATO ATC participants toward modernisation of management, as well as preparation of science and technology policies on the national level.

Management of quality and finances in science and research is an integral part of science management as a whole. On the other hand, it is very closely associated with other factors such as human resources; hence, it is practically impossible to separate one or two factors to develop efficient strategies and programmes of management. This intertwining and mutuality indicates the complexity, knowledge and experience that decision-makers in science management must have in order to efficiently manage science on the national level, as well as to integrate it into the European and global spheres.

The transition to a market economy has changed the overall science management context in South East European countries. Government is on its way to becoming an agent for providing a suitable supporting environment, for eliminating the deficiencies of the market, and for encouraging business enterprises toward actions that should be economically and socially beneficial. The active role of government in fostering innovation activity is still expected and needed. The development of the economy's innovation capacity needs to be nurtured, as markets alone may fail to allocate sufficient resources to R&D and other knowledge-generation activities. Sufficiently educated human resources are also very important; hence, investment into human resources, their training and education is important.

Formation of the innovation system requires paying attention to the mechanisms and institutions that form this system. Prior evaluations of the environment in which specific mechanisms successfully functioned, and comparison of the environment from which they were transferred, are necessary. Mechanical transfer of policies and programmes may produce "surrogate modernisation" rather than real structural change and upgrading.

Individual countries should define development strategies that need to be accompanied by sufficient investments into education, science, research, development and technology.

Domestic investments in research and technology development are fundamental for the creation of new knowledge and the effective utilisation of imported knowledge and technology. In South East Europe, investments in research and development have been increasing too slowly to enable individual countries to quickly reach the EU average. The business sector's share of investments in research and development is particularly troublesome. The investments of the business sector indicate only a very slow turn towards the direction of growth based on technology and knowledge.

It is clear that a well-developed science-technology base is fundamental for a successful national innovation system and market economy. The South East European countries must therefore dedicate sufficient attention to the development of their science and technology bases, to solve the problems in the research sphere as well as to deal with the challenges that research and development face in the international environment (e.g. international research networks).

1. From National Science, Education and Technology Policy to Models for Copying

The planners of a suitable national science and technology (innovation) policy must pay special attention to:

- Limited human and financial resources;
- Relatively high costs of basic research;
- Users of research – public and/or private sector;
- Long-term development strategy and commonly agreed priorities in science and technology strategy.

Due to the limitation of available resources, it is important for the implementers of a national science policy to set up management mechanisms and models that pay attention to such limitation. This also means that funds should be directed to projects and programmes that are expected to deliver the best results. At the same time, they must know that basic research has become very demanding cost-wise. Hence, it is necessary to pay needed attention to setting priorities in science. Selection should be based either on the importance of scientific work for the national economy or on its international excellence. For geographically smaller European countries, most of the countries in South East Europe, it is necessary to carefully balance these two criteria so that R&D can contribute to long-term (economic) growth and international competitiveness.

Setting priorities in science policy is also connected to the selection of a suitable strategy that can be offensive, defensive, imitating, etc. The selection of a strategy depends on the capacity and capability of implementation. In general, it can be established that the decision-makers in science in South East Europe did not pay enough attention to strategy selection. In addition, efficient and contemporary management was not characteristic for most science managers in the mentioned European sub-regions. Companies choosing an imitation strategy can be competitive in open economies only with good management. Paying special attention to management has become extremely important for the survival and development of companies. Low investments and low wages do not promote a larger role for science in the economy in the long run. A "low investment" strategy does not require scientific research activity, except for adapting foreign knowledge to national needs. The extent of cooperation between the scientific and economic spheres is in this case very meagre. Hence, the only solution in the short term is to rely on good management that is able to follow an imitation-based strategy that can exploit current human and material resources. However, this does not ensure long-term growth.

Some companies in Central and South East Europe have chosen a defensive strategy of innovation, i.e. they are not aiming to be innovation leaders but followers. Although less risky than being innovation leaders, this strategy is very demanding – it requires not only relatively large investments in imitative research and development but also highly qualified management and organisation. Therefore, such companies are quite rare in both European sub-regions now. At the same time, governments, with the help of the companies that selected a defensive strategy of innovation, could improve their positions in the broader European and global areas.

Presently, the dependence strategy is the most realistic for most companies in Central and South East Europe. Many local companies are in close relationships with foreign partners on whom they are dependent in terms of access to markets and technology or even in finance. This strategy builds on the technological leadership of foreign lead partners, but it also requires domestic quality and technological and professional knowledge. It enables companies to become trusted suppliers ("first-tiers") and to determine their mid-term perspective.

From the situation presented, it is seen that the transition in science-research activity in the countries of Central and South East Europe in the 1990s and in the first years of the 21st century was less dynamic than the economic transition. There are many reasons for this; most commonly accepted is the finding that we can look for causes in weak cooperation between the economic and scientific spheres. The findings of the NATO ATC, presented in the following text, also indicate that there is a need for modernisation of management with the help of public funds for research and development.

2. Results of the Workshop

Trainers:

Dr. Norman P. Neureiter, US Department of State, Washington, D.C., U.S.A., in cooperation with
Dr. Larry Secrest, Head of Secrest and Co., USA,
and
Dr. Janez Slak, Assistant to the Director, Jozef Stefan Institute, Slovenia

There were nine themes discussed at the workshop:

1. Creating a Favourable Environment
2. Human Resources
3. Sources of Funding
4. National Priorities
5. Balance of Basic and Applied Research
6. International Cooperation
7. How to Evaluate and Measure R&D
8. How to Develop and Grow SMEs
9. How to Attract Foreign Direct Investment (FDI)

The participants were divided into three groups, each working on three themes.

GROUP 1:
Chair: Dr. Miloš Komac (Slovenia)

1. Creating a Favourable Environment
2. Human Resources
3. Sources of Funding

GROUP 2:
Chair: Dr. Nada Švob-Đokić (Croatia)

1. National Priorities
2. Balance of Basic and Applied Research
3. International Cooperation

GROUP 3:
Chair: Dr. Slavo Radosevic (UK)

1. How to Evaluate and Measure R&D
2. How to Develop and Grow SMEs
3. How to Attract Foreign Direct Investment (FDI)

The results of the workshop groups were discussed at the final plenary meeting.

GROUP 1

Creating a Favourable Environment

The participants agreed that the creation of a favourable environment for long-term growth would require the following targets:

- Increase GERD/GDP share by at least 1% within the next 10 years[1];
- Implement appropriate tax incentives;
- Increase the capacity of HE and R&D institutions to co-operate with industry;
- Increase the number of private research-promoting foundations and the intensity of international cooperation;
- Encourage multidisciplinary education on IPR issues and innovation management and financing;
- Encourage the transfer of researchers from HE and public R&D institutions to industry and vice versa.

Human Resources, Sources of Funding

When discussing human resources, the participants discussed the problem of "brain drain". They pointed out the following:

- One has to distinguish between real brain drain and normal "brain exchange".
- A certain amount of brain drain is anticipated in the first years after accession to the EU. It is believed that it will level off with time and will be transformed into "brain exchange" or even "brain gain", i.e. return of professionals to their home countries as incomes increase.
- To prevent brain drain, all possible sources of funding have to be increased and/or used more effectively:
  - Public and private funding for R&D;
  - International sources such as EU Framework Programmes and Structural Funds;
  - Private foundations;
  - Venture capital funds;
  - Industry contracts – both domestic and foreign;
  - International development assistance funds;
  - Entrepreneurs (individuals).

[1] Some countries like Slovenia and Croatia already have GERD/GDP above 1%.

GROUP 2

National Priorities

The capacity to clearly state national research priorities was questioned. The states of the South East European region are weak, small, and trying to define a general strategic approach to their national development in European and global contexts.
The main difficulties in making decisions on national research priorities are the following:

- Lack of methodology;
- Undefined developmental context (vague economic policy, questionable decision-making processes, and pressure of short-term political priorities over long-term developmental priorities, etc.);
- Low level of public understanding of specific research and scientific fields and their societal role.

The balance between national and international priorities was particularly stressed:

- Specific national and inherited priorities should be recognised: cultural heritage, identity problems, social change, etc. Dynamic processes of changing national identities should be seriously considered.
- Strong identification with the European economic and social model brings about adaptation to international priorities, particularly European ones. A strong feeling was expressed that European priorities should be followed.
- Regional and global consideration should be balanced when defining priorities.
- Specialisation in research should reflect inherited strengths in science and technology and acceptance of European and global standards.
- Some universal priorities should be respected: quality-of-life, health, energy, environment, and bio-diversity.
- Priorities have to be supported financially.

Balance of Basic and Applied Research

Basic research is supposed to prompt scientific excellence, while applied research is very relevant to overall economic and social development. There is no universal ratio, and the balance will always depend on specific country conditions as well as on the time when research is carried out. Applied research can also influence further development of basic research, and vice versa. Schemes like 30% basic, 30% applied, and 40% developmental are therefore rather artificial and hardly practically applicable. More flexible approaches are welcome and needed.

International Cooperation

International cooperation opportunities are not fully utilised. It is often easier to get national funding than to enter international scientific competitions. However, international scientific cooperation is essential for scientific development, particularly for countries with limited scientific capacities.

The standpoints taken are the following:

- Regional cooperation has to be upgraded. Adequate mechanisms should be developed and tested in the region through larger regional research projects.
- Bilateral cooperation should lead to multilateral. Some countries from the region have well-developed bilateral scientific cooperation (e.g. Croatia), while others have not yet developed bilateral scientific contacts (e.g. Albania and Bosnia).
- Almost all countries from the region participate in all-European multilateral programmes like COST, EUREKA, INCO, FP 5, and FP 6. In order to support this cooperation, increased national efforts, both organisational and financial, are needed.

GROUP 3

How to Evaluate and Measure R&D

Peer review is recognised as a unique set of methods for the selection and funding of projects, but with many variances. All of them have a common denominator: promotion of meritocracy. The best proposals are to be supported by public funds and only peers are qualified to decide. The most important issue is to introduce meritocracy into the rationale of project selection by peer communities and to bind the relevant political authorities to accept the decisions made by these communities.

Peer review may take place in one or two successive steps. The first step involves an expert who evaluates applications individually and marks them based on their scientific and technical merit. The second step aims to homogenise the outcome of the first phase and give a ranking of proposals so that selection for funding is easier. Also in this stage, proposals may be ranked by taking into account additional criteria – like technological and/or economic relevance.

The technical features of the evaluation procedure depend on the type of research to be funded (academic, technological, etc.), the discipline, the time available for the evaluation, and the budget available for implementing evaluation, compared to the budget of the (a) programme and (b) individual projects to be funded.

Criteria are based on the past performance of the research team and the principal investigator. In some cases, funding institutions ask for a business plan for the exploitation of results. In other cases, evaluators slide from official criteria to their own personal perceptions.

The key problem of peer review procedures is how to ensure not only the quality but also the relevance of project proposals. This is usually resolved by a two-step procedure whereby projects are first selected based on quality. In the second step, this ranking is modified by taking into account criteria of scientific, social, economic, or commercial relevance.

How to Develop and Grow SMEs

- A developed financial system with diversified sources and types of funding is essential for dynamic SMEs and an innovative SME sector; these systems are still very much undeveloped in countries of South East Europe.
- A legal framework is necessary in order to ensure respect for property rights and contract enforcement.
- Public attitudes towards technologically based entrepreneurship have to be improved.

How to Attract Foreign Direct Investment (FDI)

- A sensitive and complex policy area such as FDI is affected by a variety of policies (FDI policy; property rights; innovation policy; land policy; quality of national innovation system, etc).
- Legal/governmental guarantees are necessary.
- FDI has a crucial role to play in transforming the economy into a free market economy, though FDI alone is not sufficient. FDI has to be complemented by policies for stimulating national innovation systems.
- Governments need to encourage multinational companies to make R&D/knowledge-based investments, in addition to manufacturing.
- Technology-oriented FDI is not as flexible as low-wage-based investment, and factors that attract this type of FDI cannot be developed overnight. This calls for a

formulated domestic economic development strategy, in particular an innovation-oriented infrastructure, which would complement or benefit the strategies of MNCs.
- Concrete actions should be taken to create favourable conditions for FDI. However, direct financial incentives are limited unless there are other favourable conditions like a skilled labour force.
- Foreign companies should accept commitments to improve infrastructure, keep labour/working positions, and accept social commitments.

Conclusion

The transition from centrally planned economy to market economy in the countries of Central and South East Europe, as well as the accession of some of them to the EU, caused a redefinition of the role of their research and development systems. It became clear that a well-developed science-research base is fundamental for the success of national innovation systems and for the international competitiveness of national economies. For the time being, there are large differences among countries as to how much attention they pay to the management of quality and public finances in science. The analyses of the past decade indicate a relatively low interest among science managers to change their role and hence attain modern knowledge. The content and poor understanding of science management is consequently not surprising. Nevertheless, the Europeanisation of the RTD systems of these economies has begun and will have profound effects on their science management. Yet this by itself will not guarantee that national S&T systems will benefit their societies and economies. As pointed out above, the danger of the mechanical transfer of schemes, programmes, and approaches to these countries is quite substantial. Also, policy-makers may be myopic when it comes to understanding the specific problems or conditions for beneficial R&D.

The participants of the NATO ACT listed only general factors or conditions for successful scientific research activity on the national level. Nevertheless, the descriptions and analyses of the state of scientific research and innovation activity that are presented in this volume provide valuable material for the reformation and development of national science, education, and technology policies, considering the evaluation of conditions in research and development in any individual country. They also give a good foundation for creating grounds for the management of quality and public finances in science.

E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 17

Peer Review – From a National and International Perspective

Dr. Paul RAMBAUT
Member of the NATO Advisory Panel on Science and Technology Policy

Abstract. Peer review has been used to judge the quality of science for several centuries. It is now the standard method by which proposed research projects are selected and funded by government agencies in much of the world. By focusing on the peer review process that is employed by various agencies in the United States and elsewhere, the advantages as well as the disadvantages of the system are highlighted. Ideally, peer review helps scientists do their jobs better by giving them feedback from others. It also helps control the quality of scientific research and scientific publications. The process makes it more likely that research funding is distributed on the basis of scientific merit and that quality criteria will prevail over social, economic and political considerations. However, the process is often overly bureaucratic, time-consuming and inaccurate. It tends to cater to scientific elitism and to discount more practical considerations. Applicants whose proposals are reviewed frequently get discouraged by unconstructive and negative comments. Reviewers are often frustrated by the sheer volume of paperwork they are asked to review along with the inclusion of detail that obscures more critical issues. Overemphasis on peer review may also discourage the funding of innovative research because peers tend to view research somewhat conservatively. For peer review to be effective, the system must be more efficient in focusing the attention of peers on legitimate scientific issues rather than on considerations that are more effectively handled by agency administrators. Regardless of its shortcomings, however, peer review will remain the mainstay of formal scientific evaluation for the foreseeable future. With the advancement of the Internet and electronic publishing there is the potential, on the one hand, for improving the current system and, on the other, for un-reviewed, second-rate science to further dilute the world's scientific literature. Even in this world of instantaneous communications, some system of quality assurance must survive for science to continue to advance.

Introduction

It is a pleasure to be able to address you on the subject of peer review. It is a process I have managed in several U.S. government agencies as well as at NATO. It is not one with which I am blindly enthusiastic, but rather one I regard as the least objectionable approach to the evaluation of research in a large bureaucracy.

In smaller organizations with scientifically involved and competent managers, I believe there are more satisfactory ways of deciding what research to sponsor and what not to sponsor.

Formalized peer review has been used for over three centuries. Historically, it has been employed extensively to determine the course of future research. Today the process is used to evaluate research plans before they are implemented, to evaluate ongoing research and to evaluate the results of research. Most significantly, peer review has become the standard method by which proposed research projects are approved and funded by government granting agencies in much of the world [1].

This is particularly important because most scientific research is funded by government agencies. To obtain government funds for a scientific research project, one must be able to convince others that one has an idea that has the potential to contribute to knowledge and, usually, that this idea will advance a subject that is a national priority and is deserving of taxpayers' support [3]. The idea must usually be presented in writing and it must usually be judged in a very structured and objective manner.

Peer review *is* that formal and objective process. It is the process that, in principle, ensures that any proposed research project is reviewed by a group of experts in the field. These experts look at the quality of the proposed research and compare it to other research in the field and to the universe of knowledge in the subject area.

Without peer review, it is quite likely that research money, whether from the government or elsewhere, would be distributed in a haphazard manner based on chance, pressure groups and local politics rather than on scientific merit [1].

Karl Friedl, Ph.D., who has directed the U.S. Army's Military Operational Medicine Research Program at Fort Detrick, Maryland observed that "peer review is a cornerstone of the scientific process. Without open and critical discussion of research results, both logical and flawed analyses may be given equal weight, making it much more difficult to manage any research program" [3].

1. Problems with Peer Review

Peer Review, however, is not without its detractors.

The process has been described as "unjust", "usually ignorant" and "frequently wrong" by no less an authority than Richard Horton, the editor of the eminent British journal The Lancet [2].

According to Horton, editors and science managers alike wrongly portray peer review as a "quasi-sacred process that helps to make science society's most objective truth teller". However, he says, "we know that the system of peer review is frequently biased, unjust, unaccountable, incomplete, easily fixed, often insulting, usually ignorant, occasionally foolish and frequently wrong."

Others charge that the system of peer review perpetuates a scientific elitism that tends to discount other practical considerations. Officials at the National Science Foundation maintain that, under certain conditions, overemphasis on peer review may discourage funding of innovative research because peers generally tend to view research in an unduly conservative manner.

It was reported in the Washington Post on August 30, 2003 that the Bush administration has proposed broad new standards for federal regulatory agencies that would require them to seek independent appraisals of the scientific basis for many new rules before issuing them. In other words, they would be compelled to employ peer review.

The proposal would require agencies to systematically seek outside opinions when evaluating scientific findings or disagreements. They would be required to use peer review when promulgating new regulations such as those that deal with environmental quality or transportation safety.

Critics have warned that the proposal would paralyze new regulations and stymie the enforcement of some existing ones. These critics say the process quickly gets murky when applied to such issues as global warming, pesticide use and ergonomic safety, in which the risks and benefits of regulations are complex, expensive and politically charged.

They say that, in the worst-case scenario, important public protections dealing with the environment, health and safety will get stopped in their tracks because peer review becomes a hurdle you cannot get over.

In my active career, I have seen the peer review process operate in both government and industry. The process has become much more elaborate and unwieldy over the years. However, it still boils down to having experts look over the shoulders of other experts, or would-be experts, and make judgments as to what is credible, feasible and worthwhile. It is important for managers to focus on this simple model and not become overwhelmed by, and certainly not hide behind, overly elaborate bureaucratic procedures.

2. Peer Review in the United States – A GAO Study

The United States federal government invests over $80 billion each year on research and development. This is performed by scientists in government agencies, universities, corporations, small businesses and other organizations.

Four years ago, the United States Government Accounting Office (GAO) undertook a study of the peer review system used by U.S. federal agencies [4]. Specifically, GAO was assigned three tasks:

(1) To define what is meant by peer review;
(2) To catalogue the government's peer review policies;
(3) To describe the peer review practices of the 12 federal agencies that account for about 90% of the federal R&D budget.

Among the agencies that were studied were the Agricultural Research Service, the National Institute of Standards and Technology, the National Oceanic and Atmospheric Administration, the Department of Energy, the Environmental Protection Agency, the National Institutes of Health, the National Aeronautics and Space Administration and the National Science Foundation.

3. Results in Brief

To varying degrees, GAO found that the agencies use peer review to accomplish five tasks:

(1) To assess the merit of competitive and noncompetitive research proposals;
(2) To determine whether to continue or renew research projects;
(3) To evaluate the results of research prior to their publication;
(4) To establish annual budget priorities for research;
(5) To evaluate the performance of individual scientists.

Each of these agencies has a variety of policies, orders or other internal guidance as to how to conduct peer review to achieve these various objectives.

3.1. Definition of Peer Review

There is no written, government-wide definition of peer review in the United States. Officials at the White House Office of Science and Technology Policy and at the agencies studied agreed that peer review should be an independent assessment of the technical and scientific merit of research by individuals who are scientists with knowledge and expertise at least equal to that of the researchers whose work they review.

They agreed that peers had to be individuals with sufficient technical competence to understand what they were being asked to review and that these peers should not have any significant conflict of interest. In addition, peers must have the intellectual capability and personal fortitude to make independent judgments.

3.2. Peer Review Policy

Just as there is no government-wide definition of peer review, there is also no government-wide policy that requires agencies to conduct peer reviews or dictates how the reviews should be conducted.

The White House Office of Science and Technology Policy (OSTP) maintains that peer review practices should be flexible and tailored to the specific missions of the various government agencies conducting or sponsoring research. The White House Office has insisted that uniform practices should not be dictated for every funding agency. They observe that the variety of peer review methods that are used reflects the varying nature of federally funded research with its different priorities and timelines.

On this same issue of flexibility, a July 1996 National Science and Technology Council report also emphasized the need for flexibility in implementing peer review. It said that the various government agencies must devise the most appropriate strategies that will nurture fundamental science and also support their national mandates. The strategies should be designed to respond to surprises, pursue detours and revise approaches in response to new scientific information and technical opportunities.

3.3. Peer Review Practices

U.S. government agencies use a combination of external and internal reviewers. The agencies employ their own scientists, and they also bring in outside scientists to do peer review. The agencies conduct the peer reviews by mail or by convening panels. They also sometimes use a combination of these two methods. Agencies differ widely in the number of reviewers they use.

The agencies use various criteria to assess proposed research, including technical and scientific merit, relevance to mission and the qualifications of the investigators. Peer review is often not simply used to judge scientific merit; it is also used to judge a variety of other factors that go into the funding decision. Such factors include management procedures, financial planning and equipment needs.

Agency officials generally consider the recommendations of peer review on all these factors before making their funding decisions.

The role of peers in making judgments on matters other than scientific merit highlights a characteristic of the peer review process that has, for better or for worse, taken on increased emphasis in recent years. On the positive side, peer reviewers, who themselves conduct research, are often in the best position to judge such matters as equipment and personnel needs as well as the managerial and financial aspects of research. In the worst case, agency managers hide behind peer review when they seek to avoid having their own funding or relevance decisions called into question.

In addition to evaluating research proposals, the agencies also use peer review to evaluate research that is in progress. Generally these reviews are used to determine if funding should be continued for a particular project or for the laboratory as a whole.

In general, U.S. government agencies also encourage scientists to publish the results of their research in professional journals. Since such peer reviews are organized by the journals themselves and are independent of the government process that initially endorsed the research, they amount to another level of peer review for government-supported research.

To illustrate some findings of the General Accounting Office study, I would like now to turn to some specific U.S. government agencies.

3.4. The Agricultural Research Service

The Agricultural Research Service is an agency of the U.S. Department of Agriculture. Its annual budget is over $800 million. Of this, about $4 million is awarded to external scientists. The agency spends $800,000, or about one fifth of its research budget, to conduct peer review to determine how this $4 million budget is distributed.

The agency excuses this high expenditure by saying that peer review is expensive because of the cost of the panel process. Panel members receive honoraria of $150 a day as well as travel and living expenses. It should be noted, however, that, while most agencies pay the expenses of their panelists, it is more unusual for them to pay honoraria.

The agency manages 1,100 ongoing research projects that each last from three to five years. This means that, each year, 200 to 300 projects require funding decisions. The Agricultural Research Service uses, as its peer reviewers, its own scientists, provided that they are not involved in the funding decision and, in addition, individuals from universities and so-called customer or stakeholder groups.

To review research that is in progress at grantee organizations, ARS periodically convenes panels that meet in a workshop format.

ARS uses panels of in-house scientists to evaluate the work of its own staff scientists. The results of these reviews can be used to determine a scientist's promotion potential.

3.5. The National Institute of Standards and Technology

NIST's primary mission is to work with industry to develop technology, measurements and standards. NIST's annual budget is about $641 million and includes about $233 million for R&D in its own laboratories.

NIST uses a mix of internal and external reviewers for peer review of its externally funded grants and its internal research programs.

3.6. The National Oceanic and Atmospheric Administration

NOAA's mission is to describe and predict changes in the Earth's environment and to conserve and manage the nation's coastal and marine resources. NOAA's research is used to support policy decisions. Virtually all of its research is evaluated by some type of peer review process.

The peer review processes used vary within the agency. For example, in the National Ocean Service, competitive research proposals are peer reviewed in a two-step process. First, the proposals are distributed to experts who prepare individual, anonymous reviews. Second, a panel of additional experts is provided the individual reviews along with the proposals for discussion and ranking. Proposed research is judged on scientific rationale, technical merit, qualifications of the researchers and the cost of the proposed research.

3.7. The Department of Energy [5]

DOE's mission is to ensure that the country has a reliable energy system that is environmentally and economically sustainable. It is also charged with stewarding the nation's nuclear weapons and for cleaning up old nuclear weapons facilities.

DOE's annual research budget is about $7.8 billion. Approximately 80% of this budget supports research and research facilities within DOE's network of national laboratories, which includes such well-known facilities as Los Alamos and Lawrence Livermore. The remaining 20% of the research budget is used to support external research in industry, universities and other organizations. This is done through grants, cooperative agreements and contracts.

DOE also uses peer review to guide the direction of its research programs and to judge the progress they are making.

For externally funded research at DOE, peer review is regarded as an essential part of the competitive selection process and as part of the award renewal process.

In addition, DOE's own laboratories have committees of outside experts that provide periodic peer reviews of research relevance and quality. Research results are also extensively published in peer-reviewed journals. This provides the second independent type of peer review described earlier.

DOE's regulations specify that each grant proposal normally receives a minimum of three individual reviews followed by a panel review.

All of the Department's contracts for the management of its nine national laboratories require regular reviews of the contractor's performance. The national laboratories also have various industrial advisory panels to review research. In addition, all research subcontracted by the laboratories to outside researchers generally requires periodic evaluations of the subcontractor's performance.

For classified research, where matters of national security are at stake and where there is no broad industrial, university or other independent source of expertise, a process of internal peer review is used. For example, every five years, the three laboratories involved with nuclear weapons are evaluated through a formal internal peer review. The University of California, the contractor that operates the Lawrence Livermore and Los Alamos laboratories, also uses a panel of the President's Council on National Security to assess the nuclear weapons program.

A study done by an expert committee of the National Academy of Sciences found that the criteria used by the Department of Energy to select its peer reviewers were adequate to ensure the technical credibility of the process. However, the committee recommended that DOE explicitly exclude its own staff and contractors from consideration as reviewers.

The committee stated that, although it considered technical reviews by DOE staff as extremely valuable, such reviews cannot substitute for peer review. Peer review by external reviewers is a form of independent validation and a "reality check" on the quality of research.

Peer review is meaningful only if DOE, and for that matter any organization, makes it a vital part of the decision and management process throughout the organization.

The National Academy committee emphasized that, for peer review to be effective, its results must be used in making decisions regarding research. The committee rightly observed that there is nothing more disconcerting to reviewers than for their recommendations to be ignored. It encouraged DOE to require more detailed feedback describing how the recommendations of peer review were taken into account.

3.8. The Environmental Protection Agency

The mission of the Environmental Protection Agency is to safeguard the natural environment. For this, the agency receives an annual research budget of about $547 million.

EPA is legally mandated to conduct peer review of all research proposals submitted for funding. Panels of independent researchers review these proposals by using evaluation criteria that emphasize the quality of science as well as the responsiveness of the proposals to the agency's needs.

Proposals that are rated very good or excellent by the panels are subjected to further review within EPA to ensure a balanced research portfolio. In addition, EPA's Science Advisory Board, whose deliberations are open to the public, provides consultation and oversight of this portfolio.

Like other agencies, EPA also encourages its staff scientists and the scientists it funds outside the agency to publish in peer-reviewed literature.

Generally, a more elaborate and formalized panel-type review is conducted for work that is more scientifically complex, more expensive or more controversial. Other projects that are of lesser impact may be reviewed by individuals, because such reviews are considered faster and less expensive.

3.9. The National Institutes of Health

The National Institutes of Health (NIH) is the U.S. federal government's focal point for biomedical research. Its mission is to uncover new knowledge that will lead to better health. To this end, NIH conducts research in its own laboratories and supports the research of scientists in universities, medical schools, hospitals and research institutions in the United States and abroad.

The annual research budget for NIH is about $15 billion. About 82% of this is spent on grants, contracts or similar awards to organizations outside the agency.

Almost all research funded by NIH is peer reviewed by panels of outside experts. The Center for Scientific Review at NIH is the internal NIH department that is responsible for conducting most of this peer review.

Referral officers in this office review the contents of some 40,000 applications annually; they are distributed between three annual review cycles. The referral officers use written guidelines to assign each application to a peer review panel or, in NIH parlance, a Scientific Review Group.

These Scientific Review Groups judge an application's scientific and technical merit, assign priority scores and make budget recommendations. The specific criteria used to assess the merit of a research project include the significance of the project, the research approach, the innovative potential of the research, the qualifications of the investigators and the environment in which the research will be conducted.

The law and regulations require that no more than 25% of reviewers can be NIH staff researchers. However, to ensure independence, almost all peer review is performed by outsiders and only about 1% is performed by insiders.

The Scientific Review Groups are each composed of 18 to 20 individuals who review as many as 60 to 100 proposals at each of the groups three annual meetings. NIH appoints review group members from among the most productive researchers in the biomedical community to serve multiyear terms. Criteria for selecting the reviewers include demonstrated scientific expertise, a doctoral degree or its equivalent, mature judgment, balanced perspective and objectivity, an ability to work effectively in a group, an interest in serving and an adequate representation of women and minority scientists. The latter are drawn from traditionally underrepresented ethnic groups in the United States.

The Scientific Review Groups are frequently assisted by temporary panel members and by other individuals who submit opinions in writing without participating in the panel discussions. When a proposed research topic does not match a review group's specialties, or when an application might create a conflict of interest, NIH may convene a special panel to conduct the review. The Scientific Review Groups usually meet together in person three times a year for two to three days, but they sometimes use teleconferencing.

The outside scientists who perform peer review for NIH are not paid for their services. They are paid only for their travel and living expenses. From an altruistic standpoint, peer reviewers regard service on NIH panels as a moral obligation to "Science". Practically speaking, peer reviewers obtain an advance view of the research ideas of their scientific colleagues and competitors.

By definition, NIH considers peer review recommendations as advisory only. However, while other factors such as maintaining a variety of research topics and the need to support newly emerging areas of science are considered, most awards follow peer review recommendations. Of about 40,000 grant applications submitted to NIH each year, up to 30% are funded.

For each institute, a National Advisory Council meets three to four times a year to conduct second-level reviews of all eligible applications. As mandated by the Congress, these advisory groups typically include about two-thirds outside scientists and one-third lay members, such as lawyers, economists and members of patient and disease advocacy groups.

These councils ensure that the scientific peer review process has been conducted appropriately. They also make recommendations about funding particularly meritorious applications that are seen as very important but which may not have received the best scores from the scientific reviewers. Commendably, such applications are singled out by NIH staff for special Council consideration. It is less than commendable, in my opinion, that NIH staff is unwilling or unable to make funding decisions without Council backing.

Boards of scientific counselors review the technical and scientific quality of each NIH institute's ongoing intramural research. The boards meet two or three times a year.

As with other agencies, NIH administrators encourage scientists to publish the results of their work in professional journals. The NIH administrators then follow citation indexes, in which citations to peer-reviewed articles are compiled, in order to gauge the relevance and success of the work they have supported.

The NIH peer review process is very elaborate and formal. It has, no doubt, led to the support of a great deal of very productive research. It is, however, expensive and very time-consuming, both for reviewers and for those who administer the process within the government. For the latter, in particular, the process may be somewhat demeaning in the sense that it employs highly qualified scientists in not much more than secretarial capacities.

While I was at NIH in the mid-1980s, I chaired a panel to revise the procedure for reviewing the so-called "Program Project Grant" or PO1 that was used by NIH's National Cancer Institute to fund multiyear, multi-million-dollar projects that involved teams of investigators working on a coordinated research approach to a particular disease process. Prior to my coming to NIH, applications for such grants received at least two peer reviews – one by a panel convened at NIH and one by a team of site-visitors. My colleagues and I were successful in eliminating the first round of reviews and a new, expedited, single-tiered review process was used for a number of years. However, as time went on, bureaucracy triumphed again and the new process was abandoned in favor of the more conservative and bureaucratic two-tiered process.

Improvements could be made in the NIH process, in particular, by concentrating the efforts of reviewers on technical issues rather than burdening them with administrative detail. The NIH officials in charge of the process should have much greater responsibility for extracting from research proposals the concepts that are in need of peer review, and they should have exclusive responsibility for making decisions and recommendations on issues that do not involve judgments on scientific merit.

3.10. The National Aeronautics and Space Administration

The National Aeronautics and Space Administration's annual budget for research and development is about $10 billion. Of this, about $3.5 billion is spent on external research that is funded through grants and contacts.

NASA regulations dictate that peer review be used to evaluate and select research for funding. In contrast to most other agencies, intramural research conducted by NASA scientists is also subjected to the same open competitive solicitations and peer reviews that are used to select extramural research.

A committee on Space Biology and Medicine of the National Academy of Sciences found that this NASA practice of applying the same peer review process to in-house and extramural research contributed importantly to the credibility of intramural NASA research and the respect it had within the extramural scientific community.

The reviewers used by NASA in its peer review process include scientists from public and private academic institutions, industry and government laboratories both in the U.S. and abroad. Criteria for selecting these reviewers include the research they have conducted, their publications, their knowledge and experience and their ability to conduct impartial reviews.

NASA and its support contractors maintain databases of discipline experts who can serve as reviewers in particular disciplines. Acknowledged experts in a discipline and the applicants themselves may also suggest reviewers. The reviewers work on a voluntary basis as they do at NIH and most other U.S. government agencies.

Reviews are conducted by mail and by panel meetings. Mail reviews are conducted to allow for the selection of reviewers with very specialized expertise to review highly specialized proposals. Often a panel review is conducted to reconcile differences among mail reviews and put the proposed research in a larger scientific and programmatic context. Typically, NASA receives a total of over 5000 proposals annually.

If a proposal is rated highly by a peer review panel, and if NASA officials determine it to be relevant to the agency's mission, it generally will be funded.

While the NASA peer review system has become steadily more formalized over the years, it is still a very effective system in my judgment. External reviewers are asked to judge issues in their area of expertise, and internal NASA scientists and administrators are asked to judge the proposals in the context of NASA's needs and experience.

The paperwork burden is still reasonable and the process is still relatively expedient – particularly when it involves ground-based research. Unfortunately, proposals for space flight experiments are subjected to an extremely protracted process. This is, however, a function of their very high cost and the scarcity of flight opportunities.

This was not always the case. When I joined the space agency as a young scientist at the beginning of the Apollo moon landing project, the in-house NASA scientist was typically charged with addressing a particular space flight-related problem using a combination of in-flight and ground-based experimentation. The NASA scientist was at the head of a team that included other intramural scientists as well as whatever outside expertise and research capabilities were needed.

Research portfolios were assembled by selecting from research proposals submitted to the agency and by soliciting proposals from well-known experts. Incoming proposals were analyzed by staff scientists for key technical issues. Advice on these issues was sought from other experts prior to funding. This was frequently done in a telephone conversation, personal visit or by mail. There was no e-mail in those days.

Prior to the moon landings, when NASA was still very young, this system worked well and was rewarded by some very well-publicized accomplishments. Whether such a system could be employed today in the post-Challenger, post-Columbia environment, is doubtful.

3.11. The National Science Foundation

The National Science Foundation (NSF) has as its purpose the advancement of science and engineering. Its annual budget is about $3 billion. Of this, $2.5 billion is allocated for research, which is funded through grants and agreements with almost 2,000 colleges, universities and other research and education organizations. NSF annually receives about 30,000 proposals requesting new or renewed support for research. About 10,000 new awards are made annually.

NSF's peer review system focuses on the intellectual merit of the proposed activity, the qualifications of the investigators, the creativity of the activity, its ability to promote teaching and learning, its ability to enhance the infrastructure and its potential benefits to society. The performance of the investigators in prior NSF research grants is also an important factor.

Proposals are reviewed by a scientist or engineer who serves as an NSF program officer and usually by three to ten other persons outside NSF who are experts in the particular field.

Applicants are invited to suggest names of persons they believe are especially well qualified to review their applications or persons they would prefer not review the proposal. These suggestions serve as one source in the reviewer selection process at the program officer's discretion.

Program officers may obtain comments by means of mail reviews, review panels or site visits before recommending funding. Senior NSF staff further review the program officer's recommendations before awards are made.

Large projects, in terms of the number of investigators involved, the time frames of the grants or the dollar amounts involved are evaluated by outside experts who visit the sites where the proposed research would be performed.

NSF also believes it is important to conduct some exploratory research that may not fare well under the scrutiny of traditional peer review. Such research is often needed to further expand knowledge in certain areas. To this end, up to 5% of the research budget can be used for newly emerging research areas that are reviewed by NSF staff but not necessarily by external peer review.

This counteracts the tendency, noted earlier, for peer review to select research that is somewhat conservative and for it to exclude projects that reviewers consider high risk or exploratory.

4. Peer Review and the Internet

Faced with the advancement of electronic publishing, there are concerns about the future of the peer review system as it is currently operated. The community within which scientific practice is now conducted is increasingly global with the increasing mobility of information, labor and materials.

For the future, the mobility of information will be based on computers, the Internet, fax, mobile phones, etc. The unifying theme in this globalization is the effort to overcome all forms of resistance to immediacy in information exchange.

Recently, in the United States, the launch of a new on-line, peer-reviewed, biological journal was much heralded. This promises to radically alter the exchange of scientific information by making vital research freely available to anyone with access to the Internet. The new biological journal was founded by Michael Eisen of the Lawrence Berkeley National Laboratory, Nobel laureate Harold Varmus and Stanford University's Patrick Brown. One paper, published in the first issue of this journal, was accessed 500,000 times in the hours immediately following its posting.

This journal and other on-line journals are peer reviewed in very much the traditional manner. But clearly, as more scientific information is published directly on the Internet, there will be a temptation to shortcut or to dispense with peer review and to allow unreviewed information to be added directly to the global electronic database. The damage to science that can result from building an information base from such unfiltered components is incalculable.

5. Conclusion

Peer review helps scientists by providing constructive criticism. It helps science by controlling the quality of scientific research and research publications.

However, peer review does not always work perfectly. Sometimes, great research proposals or publications are rejected because they are far ahead of current scientific thoughts, and sometimes scientists get discouraged by negative or rude comments from their peers.

For peer review to be effective, reviewers need to respect each other and provide criticism that will be helpful rather than destructive.

Those who administer the peer review process must employ reviewers effectively and not burden them with materials that can be more efficiently handled by sponsoring agencies.

It is unclear how peer review practices will fare in this world of instantaneous information. How will distinctions be made between good and bad science in an electronically globalized environment? Can a “filter” such as peer review, with all its inherent delays, survive?

Survive, however, it must, if quality control is to be maintained and if the unchecked exposure and dissemination of ill-founded research reports is to be prevented.

References

[1] Ian R. Hart, The Peer Review Mechanism for Funding Medical Research. Thyrobulletin, Vol. 7, No. 3, 1986.
[2] Richard Horton, Peer Review “biased, unjust and ...wrong”. Medical Journal of Australia, 23 February, 2000.
[3] Karl Friedl, U.S. Army Lt. Col., Director of the U.S. Army’s Military Operational Medicine Research Program at Fort Detrick, MD.
[4] United States General Accounting Office, GAO Report to Congressional Requesters, March 1999 Federal Research, Peer Review Practices at Federal Science Agencies Vary, GAO/RCED-99-99.
[5] Committee on the Department of Energy – Office of Science and Technology’s Peer Review Program Board on Radioactive Waste Management Commission on Geosciences, Environment, and Resources National Research Council, National Academy Press, Washington, D.C., 1997.

Modernisation of Science Policy and Management Approaches in Central and South East Europe
E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 18

Interest Representation, Networking and Lobbying for R&D Interests in Brussels

Dr. Boris CIZELJ
Slovenian Business & Research Association, Brussels, Belgium

Abstract. Unless Europe takes a very different attitude towards entrepreneurship and the entire innovation process, it is useless to talk about the Lisbon Agenda. The gap between Europe on one side and the US and Japan on the other has continued to increase after the year 2000. The only EU countries contributing substantially more to GERD in 2002 were Sweden, Finland, Denmark and Belgium, while the EU-15 average reached 1.99% for public and private sources together.

New members and accession countries face an additional gap vis-à-vis the EU-15 in most aspects of R&D and competitiveness. These countries are not joining only the Single Market but also the creation of the European Research Area. In order to be able to benefit fully from European RTD funding, they need to enhance their links with research communities in existing member states. In addition, they should install R&D lobbying offices in Brussels, as most member states have. At the moment, there are only four from accession states (Hungary, Lithuania, Slovenia and Poland) along with an office from Turkey.

1. The Growing Economic Gap between the EU and the US

1.1. The Dimensions of the Gap

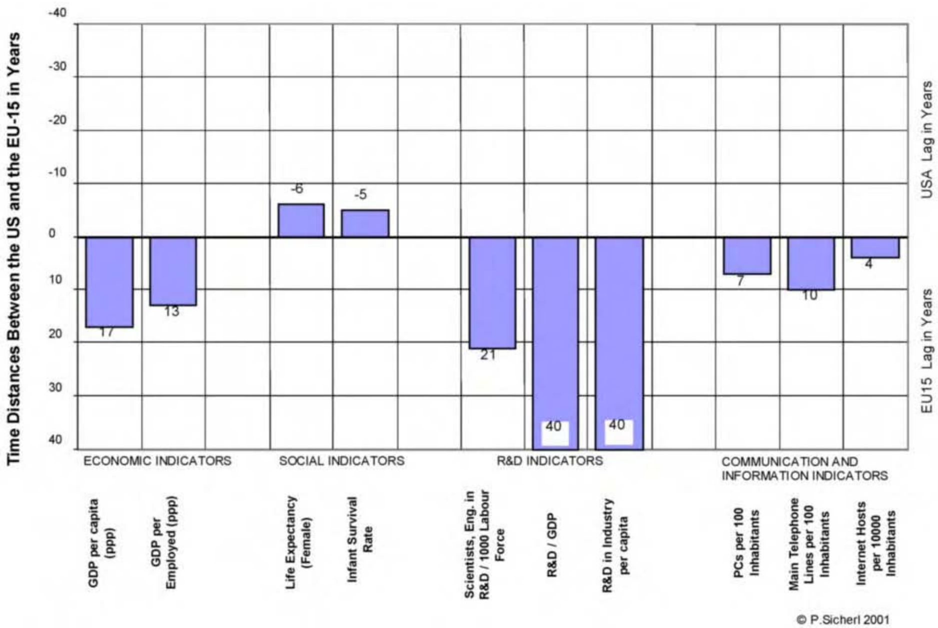
Measured through the most representative economic indicator – GDP per capita, the difference between the EU and the US has grown since mid-1980 from 15% to 35%; this is quite serious. One should not overlook that productivity expressed in GDP per hour worked is about 10% higher in the US and that Americans officially work approximately 15% more hours than we do in Europe.

The share of high tech products in total exports is exactly two times higher in the US than in the EU, and consequently the share of the world market in 2000 was 21.8% for the US, 17.6% for the EU and 13.3% for Japan.

In 2000, the EU countries registered 135 patents per million of population on average, while for the US the figure was 144 (for Slovenia the figure was only 25 patents per million of population). When we compare the share of high-tech products in total exports, the US is leading even more convincingly: 41% versus 20% for the EU-15.

On top of that, European growth rates have lately been substantially lower than the rates achieved in the US.

When Professor P. Sicherl of Ljubljana University and SICENTER compared the differences between the EU and the US through his application of the time-distance method-



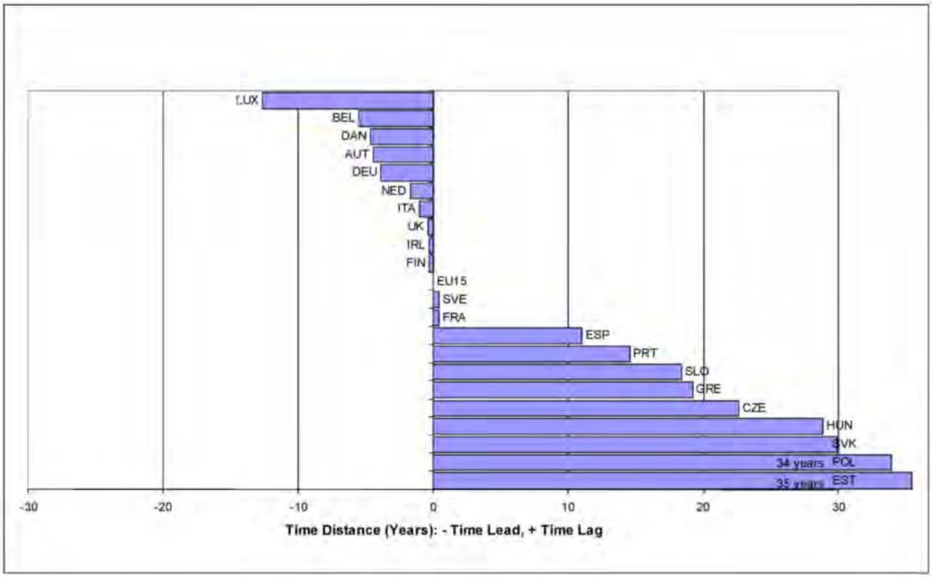
Graph 1. Time Distances Between the US and the EU-15 in Years.

ology, the dimensions of the gap were even more compelling. The EU-15 will need 14–17 years to achieve some of the current US economic parameters (GDP per capita and GDP per employed), but 21–40 years for some of the key R&D parameters (GERD versus GDP, R&D expenditures in industry per capita, and share of scientists and engineers in the labour force). However, in some social indicators (life expectancy and infant survival rate), Europe is still ahead. The question is, how can the countries of the EU, under the circumstances of growing economic disparities, expect to maintain their high standards of social and health security – labelled as the European social and economic model?

Using the same methodology to measure the gap between the EU-15 average and the economic performance of the accession countries, we come to an equally disturbing picture. It will take the following number of years for individual countries to reach the GDP per capita (ppp) of the EU-15 average in 1998: Estonia 35 years, Poland 34 years, Slovakia 30 years, Hungary 28 years, the Czech Republic 23 years, and Slovenia 18 years.

1.2. Lisbon Agenda – The Solution to the Problem?

In view of these facts, the conclusions of the Lisbon European Council in 2000 came as no surprise. Equally, when the Barcelona Targets (achieving GERD of 3.0% whereas the private sector should contribute 2.0% and the public sector 1.0% by the year 2010) were adopted the following year, it reflected the realisation of top European politicians that a turnaround is needed in order to make Europe more competitive and to prevent its marginalisation at the global economic level. The politicians seem to be disturbed by the growing gap, though they don't like to present it clearly to their constituencies. How can they expect the needed support from their electorates for the reforms required to reduce the gap?



Graph 2. GDP per capita (ppp) – Time Distances Between the EU-15 and Selected Accession Countries.

The main instrument for achieving the Lisbon Agenda is the creation of a knowledge-based economy requiring a substantial increase of R&D funding, together with many other complex measures and reforms. During the period 1994–2000, the US increased its total GERD by 40% (from €161 to €226 billion), Japan by 27% (from €66 to €84 billion), and the EU by only 20% (from €117 to €141 billion).

There are striking differences in GERD/GDP indicators within the EU. One could distinguish the following four groups of countries: Sweden and Finland have already surpassed 3%; Germany, France, Belgium and Denmark are over 2%; the UK, the Netherlands, Ireland and Italy are between 1% and 2%; while Spain, Portugal and Greece do not even reach the 1% mark. Although many of the new member states have recently increased their GERD effort, only Slovenia, the Czech Republic and Hungary invest more than 1% of their GDP for R&D.

What has been achieved since 2000 on the basis of the Lisbon Agenda? At the institutional and political level, it is important that the Competitiveness Council has been established and that the Commission is placing the concern for competitiveness at the centre of its activities. In this context, benchmarking has been adopted as a useful tool for comparing the performance of member and candidate countries. It contributes to the building of the political will necessary for the reforms to be introduced by the governments, and it also mobilises all of the stakeholders in their endeavours to enhance the competitiveness of the European economy.

In addition to efforts at the national level, the EU member states also need to improve the very functioning of the Union, which now even has a constitution but very often operates less than efficiently. No doubt the Union is probably the most complex international system ever created, but its efficiency is far from the level needed to achieve the ambitious yet fully legitimate Lisbon objectives.

Interest representation and lobbying admittedly plays a very important role in the European integration process, and the new members and candidates still have to fully appreciate it in order to become equal partners in the process.

2. The Lobbying Landscape of Brussels

During the last decade, Brussels has become the world lobbying capital with over 1,600 organisations involved in various forms of interest representation in the context of the European Union and with some 11–12,000 professional lobbyists operating in the European "capital".

This development is related to the phase of integration achieved by the EU in the early 1990s when most economic decisions started to be made in Brussels as the Union reached the stage of the Single Market. Therefore, it is not surprising that some 300 out of the 500 largest international corporations have offices in Brussels. These are not concerned primarily with commercial matters; they monitor the development of new European legislation and when necessary try to influence it in line with their strategic interests.

This is also the primary function of several hundreds of European professional and sectoral associations. On the other hand, representation offices of regions and cities are promoting their entities – their special assets, know-how and attractions – for European visitors. All of this is done in order to facilitate access of their constituencies to European funding.

Contrary to the more relaxed American attitude to lobbying, we in Europe still perceive interest representation as an activity often placed at the margins of legitimacy or even legality.

Under these circumstances, stakeholders from accession and candidate countries are attempting to understand how to best protect their interests and utilise the same channels of communication and influence as their colleagues from the EU-15.

2.1. The Structure of Lobbying Organisations

As shown in the table below, there are many lobbying organisations of various types in Brussels.

On average, a new office is being opened every week, while some close or restructure and consolidate.

On top of that, Brussels has the largest body of media correspondents (counting over 1,000 journalists) who follow all EU developments very closely and often influence decision-makers and public opinion in member states as well as in the rest of the world.

Type of Organisation	**Number**
Business and Professional Organisations	614
Interest Groups and Non-Governmental Organisations	257
Consulting, Law and PR Firms	195
Representation Offices of National Associations	155
Regional Representations	153
Economic, Trade and Industrial Chambers	40
Agricultural Associations	34
Employers Associations	31
Trade Union Associations	31
Church and Other Representations	28
TOTAL	**1,538**

Finally, one should not forget that in Brussels, member states have at least 3,500 diplomats in their permanent representations to the Union, whose job is also to represent their respective countries' interests.

2.2. The Activities of Lobbyists

Generally, most lobbying organisations are involved in the same type of activities. Lobbying proper – intervening in a specific issue for an individual or a group of clients – takes about 20–30% of these organisations' time and effort. One could compare it with the percentage of the total working time surgeons actually spend at the operating table. All of the rest of the time, lobbyists are engaged in: reading and studying documentation; gathering and checking relevant information with representatives of EU institutions and sharing it with their clients; representing their clients in respective European associations; and promoting their clients' interests in a more general context.

Lobbying activities can be broadly classified – according to R. Watson and M. Shackleton in "Organised Interests and Lobbying in the EU" – into the following three categories: a) private interests, pursuing primarily specific economic interests; b) public interest bodies, pursuing predominantly non-economic aims; and c) governmental actors (mostly diplomatic missions of non-EU countries).

In terms of typology, lobbying organisations can be distinguished by the following criteria:

(1) Patterns of representation of their members/clients: permanent or ad hoc, directly or indirectly;
(2) Who they represent: national associations, European associations, regions, cities;
(3) Legal status: representation office (without having legal personnel), non-profit association, or business organisation (being a tax resident in Belgium);
(4) Profile of activities: only lobbying and public affairs, or a broader spectrum of activities, such as information, training, promotion, consulting;
(5) Sector of ownership: private, public, public-private partnership;
(6) Size of organisation (measured in number of professional staff): small – less than three people, medium – three to five people, and large – more than five people.

3. Slovenian Business & Research Association (SBRA) in Brussels

3.1. A Broad-Based, Joint Representation Office

Among the numerous lobbying offices in Brussels, SBRA could be characterised by its explicit covering of both business and research interests and its broad-based public-private partnership status. SBRA was created by the Chamber of Commerce and Industry of Slovenia, the two Slovenian universities, the Jozef Stefan Institute, and the Agricultural Cooperatives Association. From the start, SBRA has enjoyed the important support of the Ministry for Science and Technology – now the Ministry for Education, Science and Sport – and the Ministry for Agriculture, Forestry and Food.

Already at the initial general meeting, the following important companies joined as associate members of the Association: Nova Ljubljanska Banka, Sava, Krka, Lek, Radenska, the Insurance Companies Association, and the Port of Koper. Now, also Istrabenz, Riko, the University of Primorska, the Chamber of Craft, and the municipalities of Novo Mesto, Ljubljana and Maribor have joined.

The diversified membership structure requires an adequate system of management. All members meet annually at the general meeting to adopt the programs and reports, and a five-member Management Board (representing all categories of members) carries out the classical management functions. In addition, the two spheres – business and research – created two standing committees, which monitor the activities of the Association from the position of their respective spheres.

Operating since May 1999 and employing five people on a full-time basis, SBRA is among the more experienced and largest lobbying offices in Brussels from the new EU member states.

3.2. The SBRA's Modus Operandi

The basic objective of SBRA has been to facilitate and encourage business and R&D co-operation between Slovenia, EU member states and EU institutions. Its activities are divided into *core* and *supplementary* activities. Core activities include:

- Informing members on EU economic developments and trends in the R&D sphere, on European legislation, and on relevant EU programs;
- Supporting the interests of its members and acting as their representative in European associations and EU institutions;
- Participating in research, consulting, training, publishing and information activities to help prepare Slovenia's business and research communities for successful operations under the conditions of EU membership.

Supplementary activities include projects having been approved by the Management Board and being financed individually by interested parties, including SBRA members. These were some typical supplementary projects:

- Phare/BSP supported "CAPE Project", coordinated by EUROCHAMBRES and carried out by the Chambers of Commerce and Industry of 10 new members – SBRA has been responsible for annual surveys (2001–2004) on corporate readiness for the Single Market among some 4,000 companies;
- Organisation of promotional conferences on: Slovenian Science and Technology (2000), Foreign Direct Investment (2001), Slovenian Information Technologies (2004);
- Publication of CD-ROM "Slovenia – Your R&D and Business Partner" (2001, 2002, 2004);
- Participation in project "SPREAD" (2004–2005).

The most recent example of SBRA promotional activities was the "SICT 2004" business conference. Under the title of "Slovenia – A New ICT Partner in the Union – Together Towards a Knowledge-Based European Economy", the conference brought together 60 representatives of Slovenian ICT companies and research institutes and over 120 European companies and ICT associations. The event was opened by the Slovenian Minister for the Information Society Pavel Gantar and the European Commissioner for the Information Society and Entrepreneurship Erkki Liikanen. The conference was co-organised by the Slovenian Ministry for the Information Society, the Ministry for Economic Affairs, the ICT Association of the Slovenian Chamber of Commerce and Industry, and the Slovenian Trade and Investment Promotion Agency – TIPO.

European participants received comprehensive and up-to-date information about the ICT sector in Slovenia (a recent study commissioned by the EU Joint Research Centre, an national strategy outline for the sector, and a specially prepared catalogue of 28 companies participating at the conference). Slovenian participants were briefed on the major regulatory and commercial challenges awaiting them in the EU Single Market and on the most relevant Community programs where they could apply for European funding. In addition, there were 68 private, bilateral meetings among potential co-operation partners.

SBRA is a member of the informal network of research liaison offices IGLO (currently 18 members), and it coordinates the informal network of interest representation offices from new member and candidate countries NIROC (currently 37 members).

In this capacity, SBRA organised a major conference on "European Funding Facilities for Companies from Candidate Countries" in the European Parliament in November 2002 and a workshop on "The Lisbon Strategy and the Candidate Countries" in Prague House in Brussels in October 2003.

During its first five years of operations, SBRA has assisted in better mutual understanding between numerous civil society stakeholders in Slovenia on the one hand, and EU institutions and member states on the other. Particularly for a young country with limited international experience, it was important to have a non-governmental institution monitoring the pre-accession process in Brussels and alerting the business and R&D communities about the opportunities to benefit from participation in various Community programs, as well as to interpret the importance of timely compliance with European legislation and norms. There is no doubt that SBRA has contributed to better visibility of Slovenia in Brussels. These functions go far beyond the conventional role of lobbying offices.

Although the Slovenian network of National Coordinators (NCPs) for all areas of EU RTD programs operates very efficiently, SBRA has still helped numerous researchers in their submissions for various calls and advised them in consortium building and in the stage of contract negotiations.

3.3. The Future Role for SBRA

These functions were required from SBRA by its membership, and with accession and several new members joining the Association, its activities will probably evolve further by focusing on the new interests of its members. SBRA has already started to adjust to the new circumstances: its information services are becoming more differentiated in line with the specific interest profiles of its members, while general information is being offered to members through various portals, such as the new EuroActiv-Slovenija service, developed jointly with the Chamber of Commerce and Industry and the Brussels-based EuroActiv organisation.

With the joining of major Slovenian cities, SBRA will obviously pay more attention to the issues of regional development and inter-city and inter-regional cooperation.

As SBRA members are enjoying full access to all Community programs now, the Association will further develop its service to help interested members identify the most suitable program and call for their possible submission, as well as prepare it in a way that secures the best chances for success.

There is no doubt that SBRA will also continue with some forms of promotional activities, thereby supporting its members to become equal partners in the European Single Market as well as in the emerging European Research Area.

All of these objectives will require further strengthening of SBRA's networking presence in Brussels as well as the development of its lobbying capabilities.

PART IV

Conclusions

This page intentionally left blank

Modernisation of Science Policy and Management Approaches in Central and South East Europe
E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

CHAPTER 19

Towards S&T-Driven Growth in South East Europe: S&T and Innovation Policy Implications

Dr. Slavo RADOSEVIC and Dr. Edvard KOBAL

Abstract. We provide a broad policy-oriented perspective on the transformation of S&T and innovation policies in SEE countries. S&T-driven growth and S&T policy are essential for South East European economies to catch up with the EU. Any approach to S&T and innovation policy that may contribute to this objective should be compatible with the requirements of a knowledge-based economy, should be firm oriented, and should attempt to integrate two opposite orientations – national innovation systems and global value chains. S&T and innovation policies in SEE countries will be strongly influenced by Europeanisation. We point out both the positive and the potentially detrimental results of Europeanisation on effective national S&T and innovation polices.

1. Introduction

The contributions to this volume analyse different aspects of S&T policy in South East Europe (SEE). In this chapter, our aim is to discuss the policy implications of different streams of analyses that are presented by national and international experts in S&T policy. We do not aim to repeat or summarise individual chapters but instead provide a broad policy-oriented perspective on the transformation of S&T and innovation policies in SEE countries. However, before we embark on this, it is necessary to point out the specificity of the SEE region, or even whether SEE can be considered as a region that shares common S&T policy challenges.

Historically, SEE was never a region in an economic sense, as its parts were either European semi-peripheral (Hungary, Slovenia) or peripheral (Greece, Romania, Bulgaria, Albania and other ex-republics of the former Yugoslavia) [1,2]. For centuries, the region was divided politically, including during the Cold War, when it was controlled by both NATO and the Warsaw Pact, with the ex-Yugoslavia being a non-aligned country and Albania fully isolated for the most of this period. With the war in ex-Yugoslavia, and economic decline during the socialist and post-socialist periods in Romania and Bulgaria, part of the SEE region has fallen behind with regard to economic development. At the same time, Slovenia and Hungary have recovered and are embarking on a process of catching up. Also, Greece, after a period of catching up during the 1960s and subsequent falling behind during the 1980s, has started to catch up. Romania and Bulgaria have been relatively successful in institutional transformation and are expected to join the EU in 2007. Whether peripheral or semi-peripheral, the SEE region has historically been dependent on the development rhythm of the core European economies. It seems that this will remain characteristic for the foreseeable future.

In summary, the fragmented nature of the region is reflected in the degree of development of its S&T and innovation policies, where some countries have embarked on a process of deep institutional convergence to the EU institutional model and are growing at rates higher than the EU15, while other countries are still struggling with basic issues of security, democracy and economic stability. Greece has been developing its innovation policy for a number of years under the strong influence of the EU (see Deniozos, this volume). Slovenia and Hungary have the most highly developed innovation policies among new member states, while Romania and Bulgaria have comparatively the most underdeveloped innovation polices when compared to the EU25 (see contributions in this volume); Croatia's innovation policy is located somewhere between these two groups of countries (see Švob-Đokić, this volume), but Serbia/Montenegro, Macedonia, Bosnia and Albania are behind Bulgaria and Romania in this respect (see contributions in this volume)[1].

Hence, it is very difficult to find a common denominator in terms of S&T policy analysis for countries that are at such different stages of policy development, different levels of income, and different degrees of institutionalisation of market systems and liberal democracy. On the other hand, the varying level of economic and institutional development is by itself a great opportunity for mutual economic benefits, knowledge exchange and institutional learning. Although trans-national institutional learning has begun to take place through a variety of assistance programmes, the entire region is not yet firmly oriented towards EU integration. A lack of complete regional consensus towards EU integration and a lack of commitment on the part of the EU towards fast integration of the whole region are both reflected in the state of S&T policy in these economies. In countries that are members of the EU or candidates for the EU, S&T and innovation policy has developed quite significantly since 1999. With the recovery, growth and institutionalisation of linkages with the EU, innovation policy in these economies has become an increasingly important element of catch-up policies. In other countries, this policy is still relegated to secondary place as they are still grappling with the issues of privatisation, restructuring, macroeconomic stability and high debt.

Continuing, we point out why issues of S&T-driven growth and S&T policy are so important in all SEE countries, irrespective of their level of development and institutional transformation. Also, we outline an approach to S&T policy that should be relevant for all SEE countries. We then analyse how S&T policy could support these economies in catching up. We do not develop policy implications in terms of normative prescriptions but instead identify common problems that are shared across the region. Our assumption is that the recognition of S&T policy problems is much more important than policy recommendations. For a policy to be successful, it has to be the outcome of a local learning process and hence policy recommendations or "recipes" are not a very productive area of S&T policy analysis. Instead, we highlight key areas of S&T and innovation policy that need to be tackled. As Europeanisation of these economies is one crucial determinant of how fast these economies will conform institutionally and economically to the EU, we analyse how Europeanisation could be beneficial in S&T policy.

[1] Unfortunately, we were unable to secure an analytical contribution on Albania; therefore, our assessment of Albanian S&T and innovation policy is based on secondary sources.

2. Why S&T-Driven Growth? Why S&T Policy? What Approach to S&T Policy?

The SEE region lost an opportunity to catch up during the first industrial revolution. Its modernisation came too late, and it had limited effects. However, as Ranki (1998) writes, after the 1860s, "in responding to Western challenges of the dual revolution, Central and Eastern Europe (thus) adopted the fundamental institutions of modern capitalism and created at least the minimal prerequisites for capitalistic economic development" (p. 11). During the first half of the 20th century, despite important short-term economic successes, the CEE region "failed to adjust in the long term to the transforming world economy, modern technology, and related industrial structures. The short-term achievements of import substitution promoted relatively rapid growth in textiles and other light industries. But this (…) failed to incorporate the structural changes occurring in the already industrialised world" (Ranki, 1998, p. 244).

During the socialist period, CEE economies made up some ground during the 1950s and 1960s but then failed miserably after the mid-1970s as opportunities for growth based on extensive accumulation of capital and absence of technical change failed to sustain further growth.

It is from this historical perspective that one can appreciate the need for S&T policy and S&T-driven growth as the only ways to catch up. The ICT revolution of the late 20th century, which clearly propelled the long productivity boom of the US in the 1990s and early 2000s, has shown that we are experiencing a new "techno-economic paradigm" and thus also a new growth regime [7]. In this respect, ICT-based structural change is another opportunity for the SEE region to modernise.

However, as history never repeats itself in the same way, we must bear in mind that the requirements for growth in the 21st century are different than they were in the 20th century. As Nelson [6] argues, learning by doing is no longer a sufficient basis for catching up, as advanced formal training and a strong science base have become substantial bases for learning by doing. Nelson [6] argues that a strong science base significantly reduces the importance of apprenticeship abroad or tutelage by foreign industrial experts. The increasingly scientific basis of industry, and the changing character of manufacturing that embodies ICT-based services, increase the importance of the higher education system in national systems of innovation.

Lundval (2004) points out, though, that "any strategy that gives technology an independent role as problem solver is doomed to fail" (p. 1). For SEE economies, the challenge is, as before in history, much broader. For example, as Danish and much other evidence at the firm level shows, introducing ICT without combining it with investments in personnel training, without changes in management, and without changes in work organisation will have a negative effect on productivity growth (ibid). At the macro level, the widened and deeper use of ICT represents a fundamental change in the economy and society (ibid). Hence, the building of relevant S&T and innovation policy is a much broader and deeper issue that is closely connected to the overall socio-economic transformation of these societies.

Knowledge-Based and Firm-Oriented S&T Policy

Growth based on the pervasive use of ICT has profound implications for S&T and innovation policy. Usually, S&T policy is concerned with the generation of new knowledge or, in the case of catching up, economies that have adopted technologies and knowledge generated elsewhere. However, extensive use of information in all production and business processes fundamentally changes the nature of catching up and requires the large-scale introduction of new business models. The capacity of an economy to distribute and absorb available information and use it in economic processes becomes essential to growth in a new "growth regime" based on ICT-intensive production systems. At the macro level, this new growth regime has been described as the knowledge-based economy. Hence, what counts is not only the capacity of society to generate new knowledge but more importantly the capacity to diffuse, utilise and demand new knowledge.

The second crucial implication of this change is that policy should attempt to support not only scientific knowledge but also knowledge in business and engineering communities by supporting different forms of "learning networks" or clusters. The capability to combine or blend different forms of knowledge – scientific or academic with empirical or hands-on experience – becomes essential to a new innovation and business process based on the Internet and different IT platforms.

The third, more traditional view of S&T policy, particularly in ex-socialist countries, is one that treats industry only from the *demand* side. Industrial firms not only generate the demand for industrial technology, but they account for a very large part of the *supply* side as well. In fact, most technology-generating capability is located in industry, i.e. in the firms themselves, not in extramural organisations be they S&T parks or R&D institutes, so the issue for SEE countries is how to increase R&D *inside* the business sector, not *outside* it. In addition, it can be misleading to only use R&D, as a large contribution to technological development is made by types of technical change that do not involve formally organised R&D at all. Today, software development is a very important knowledge component that formally does not belong to R&D but to a broader concept of intangible investments. In SEE countries, like in many CEECs, there seems to be a dearth of measures that seek to stimulate firms to undertake their own technological development. With the exception of Hungary and Slovenia, there is currently not a system that would support the growth of firms' technological activities from technology use and maintenance to technology development and creation.

National Systems of Innovation-Oriented S&T Policy

A new growth regime requires a change in conceptual thinking on S&T and innovation policy that embraces additional dimensions in a much more explicit manner. As obstacles to knowledge diffusion, utilisation and demand are much more organisational and systemic than only a matter of resources, S&T policy has to adopt systems of innovation perspective. This perspective focuses on the importance of linkages among key actors in the process of knowledge generation, diffusion and utilisation. It recognises that there is the possibility for systemic failure and not just market failure. The fragmented nature of national or sectoral systems of innovation in economies that are catching up requires support to networking within and across different professional communities. As key sources of knowledge in these economies are abroad, extensive international networking supported by cheap access to Internet infrastructure is essential to this task. Also, extensive support to human capital building, which would go beyond the immediate needs of the economy, is an indispensable condition for catching up. However, SEE countries are far from meeting these requirements. Without building IT infrastructure, which would take priority ahead of immediate economic needs, and investments in human capital (education and training), which would equalise these economies with the leading EU economies, we may not expect that they will be able to catch up.

Berend and Ranki's [2] analysis of historical evidence shows that "the educational development witnessed in the periphery was indeed a decisive aspect of its delayed economic transformation" (p. 58). Moreover, history shows this, "though the development of education was not merely a 'response' to the economic challenges of the industrial revolution. It was not demand for a better-qualified labour force, one specific to the machine age, that stimulated mass education" (p. 54). In fact, it was before the industrial revolution that a genuine educational revolution got under way, and this was indispensable for the success of the industrial revolution.

A similar parallel can be drawn between the development of railroads in CEE and the IT infrastructure of these economies. As Berend and Ranki [2] point out: "the direct intervention of the developed nations of Europe thus brought railways to the peripheral countries relatively early, and quite independently of their overall backwardness; and the railway density that was finally achieved was quite out of keeping with the level of their general economic development" (p. 97). Just as in that period it would have been a mistake to speak of oversized transport facilities, "as it was through the railways that the countries of the periphery came into contact with the European economy" (p. 100), it would equally be a mistake today to speak of over-investments in IT and Internet infrastructure. In this respect, low penetration of IT technologies and poor quality of education are major hindrances to S&T-based growth. Huge growth challenges require new solutions, which should be based on a variety of modes of governance including pure state investments, different public-private partnerships, and incentives to private operators to enter into new IT-related services.

Orientation of S&T Policy towards Integration into Global Value Chains

Human capital that is able to integrate itself into global knowledge networks, and IT infrastructure that should physically enable this, are two important aspects of the internationalisation of SEE economies. A third pillar of this is integration into foreign markets, opening of domestic markets, and integration into foreign direct investment and production networks.

A sustained recovery in SEE depends on the growth of exports to the EU, as trade within the region is currently only one tenth of its trade with the EU. Unfortunately, the EU has further fragmented an already fragmented region by differentiating access to EU markets. Stabilisation and Association agreements are very timid when it comes to free trade with some of the ex-Yugoslav states (Serbia, Bosnia). As suggested by Gross and Steinher [5], all of these countries should become part of the EU customs union. This would liberalise trade not only with the EU but also within the region, which would be the best way to integrate it into the EU.

However, we should not forget that market access alone is not sufficient impetus to growth. Institutional integration, such as closer integration of education systems ensuring a free flow of students, is an important ingredient. Also, the EU needs to develop new institutional methods of integrating SEE non-members into the EU through new forms of partnerships enabling participation in RTD, education and regional programmes.

This should be an essential complement to FDI and production networks-driven integration, which has been quite delayed in SEE. While Hungary, and partly Slovenia, have become integrated into European production networks, other countries have a very limited scale of export-oriented or pro-trade FDI[2]. Very often this is local-market-seeking FDI, which reduces rather than promotes trade (for example, Croatia and FYROM). As wage-cost differences in the region are substantial, we can hope that this might bring investors that could connect these countries as second-tier networks to first-tier networks in Central Europe or the EU15.

However, the increased positive effects of FDI are far from assured. Should host economies not have a developed "absorptive capacity", promotional policies directed only towards attracting FDI will be a waste of already limited funds. As FDI is the key driver of productivity growth and structural change, it is essential that it becomes integrated into

[2] There is some evidence that investments from Slovenia and Hungary are mainly local-market-seeking and thus do not promote trade.

domestic S&T and innovation policy. Traditionally, S&T policy is oriented towards domestic organisations. However, given the huge gaps in productivity between local firms and the know-how and technology that FDI could bring, it is essential that innovation policy is closely linked with FDI. This means integrating FDI into local programmes of vocational training, clustering, development of higher education, or IT services. It would be misleading to expect that an influx of FDI by itself could solve the problems of growth and catching up. As in the past when foreign capital went into railroads, it goes today into national telecommunications operators. This is a necessary but far from sufficient condition to ensure positive benefits and spill-over to local economies. Hence, policy that will integrate national systems of innovation and value chains, with a perspective that takes into account the changing nature of the innovation process, would be the way forward. However, even if we assume that there is understanding in the region that these are broad strategic objectives, the building of such policy is far from trivial. We turn to these issues in the next section.

3. Building S&T and Innovation Policy in South East Europe: Imported vs. Domestic Policy Production

The building of S&T and innovation policies in SEE is already, and in the future will be even more, influenced by its Europeanisation, i.e. by introduction of EU-designed and EU-funded programmes and policy practices. Given that only the EU can offer a long-term framework for growth and recovery in this region, this is not surprising. Indeed, we should not underestimate the positive benefits of the Europeanisation of S&T and innovation policies in SEE countries. Driven by EU requirements, we may expect that, similar to South EU countries, the new member states will develop new functions in several areas like structural policy, vocational training policy, environmental protection policy, consumer protection policy, and cross-border cooperation policy. The studies carried out on innovation policy in the thirteen candidate countries concluded that none of the candidate countries could be considered to have a fully-fledged innovation policy [3,4]. Hence, we may expect that EU accession will push new member states to develop innovation policy, including regional innovation policies, as one of the preconditions of effectively using Structural funds. Policy for research and technology will be expanded and modelled on EU arrangements. We may expect that it will extend towards downstream activities like knowledge diffusion, in particular through support to regional innovation policy. In R&D, EU support through Framework Programmes will establish criteria of international excellence, which will operate as reference for the restructuring of domestic R&D groups and organisations. For example, EU support to Centres of Excellence, which is followed by domestic networking and selection, already has this effect. Unfortunately, most of the SEE countries are excluded from these processes and their S&T and innovation policies will lag further behind those of their neighbours. In these countries, the local "innovation constituency" is very weak, and EU support programmes would be an opportunity to enhance the power of "innovation stakeholders".

However, similar to FDI, which by itself cannot generate catching up, the Europeanisation of S&T and innovation polices in these countries may also not be the most effective policy. As Berend [1] points out, in the Balkans, "despite the adoption of Western institutions, the economic backwardness, the pre-modern, traditional societies with a restrictive communal structure, and the existence of widespread poverty created genuine obstacles to modernisation. Consequently, most of the institutions adopted from the West lacked relevance in the Balkan context and remained formal structures without substance" (p. 10). Similarly today, there is a real opportunity that we may build instruments and organisations of S&T policy modelled on the EU that will lack local relevance and substance. The experience of Europeanisation in South EU countries shows that the strongest effects were on problem definitions, i.e. what is the relevant policy action and mechanism and what is country priority. In the case of the CEECs and SEE countries in particular, this will be compounded by the great importance of funding, which will come via Framework Programmes and in the future via Structural Funds.

As we pointed out elsewhere: “This is likely to lead to some kind of myopia where local problems and a search for local solutions may not be appreciated to the extent needed. The autonomy of CEECs in S&T policy may remain formal, as in practice the EU may affect the influence of goals, the allocation of costs, and the mobilisation of resources.

“The mechanical transfer of EU policy mechanisms may often be irrelevant to local S&T or may not be the most effective policy action. For example, the transfer of S&T parks models without regard for local demand makes these programmes highly dependent on foreign funding and barely sustainable. The transfer of policy models to support domestic clusters in conditions where there are not strong domestic organisations that can operate as “network organisers”, in whose interest it is to develop linkages, usually has limited or no effect. On the positive side, however, Europeanisation will enhance and legitimise the innovation community, which could at the same time have become one more layer of bureaucracy or civil society without domestic roots that is perceived as alien to the domestic S&T community. Although we are quite optimistic regarding the positive effects of the Europeanisation of S&T in CEECs, this by itself is not a panacea but merely a great opportunity for them to modernize their S&T systems and integrate them into the emerging EU-wide system of innovations” [8].

If we want to maximise the positive benefits of the future Europeanisation of S&T and innovation polices in SEE, then external funding should be used mainly to support new programmes, not new organisations. Rodrik [9] gives a very persuasive explanation as to why international organisations should only exceptionally aim to support the building of new organisations. He argues that there is not a no-context-specific way of achieving desirable institutional outcomes, i.e. institutional outcomes are always context specific. If so, than any transfer of ready organisational models from elsewhere will be faced with the problem that there is no unique mapping from the functions that organisations should undertake to their forms, i.e. effective institutional outcomes do not map into unique institutional designs. From this it follows that institutional forms will always be different from their designated institutional functions. This points to serious problems with the transfer of organisational models that would not only require transfers of organisational functions and organisational forms but should also ensure their compatibility.

However, what is the capacity of local organisations, civil society and policy makers to identify local priorities and design locally relevant courses of action? The “innovation constituency” in SEE countries is very weak and it is unlikely that it has the capacity to significantly shape national programmes, activities and projects in a direction that would be appropriate to a new “growth regime”. We can only hope that once civil society, enterprises and higher education institutions become involved in EU-wide networking activities, it will open a process of interaction with the EU in which S&T and innovation policy solutions could be negotiated by taking into account an understanding of local situations.

References

[1] Berend, T. Ivan. (1998). *Decades of Crisis: Central and Eastern Europe before World War II*. University of California Press: Berkley.

[2] Berend, T. Ivan and Gyorg Ranki. (1982). *Industrialisation and the European Periphery 1780–1914*. Cambridge University Press.
[3] EU. (2002). *Innovation Policy Issues in Six Applicant Countries: The Challenges*. Study funded by the EC DG Enterprise. EU: Luxembourg.
[4] EU. (2003). Innovation Policy in Seven Applicant Countries: Bulgaria, Latvia, Lithuania, Malta, Romania, Slovakia and Turkey. Study funded by the EC DG Enterprise. EU: Luxembourg.
[5] Gross, Daniel and Alfred Steinher. (2004). *Economic Transition in Central and Eastern Europe*. Cambridge University Press: Cambridge.
[6] Nelson, R. Richard. (2003). The Changing Institutional Requirements for Technological and Economic Catch-Up. Columbia University: New York, Mimeo.
[7] Perez, Carlota. (1983). Structural Change and the Assimilation of New Technologies in the Economic and Social System. *Futures* 15: 357–75.
[8] Radosevic, Slavo. (2004). What Future for S&T in the CEECs in the 21st Century. In Meske, W. (Ed.), From System Transformation to European Integration – Science and Technology in Central and Eastern Europe at the Beginning of the 21st Century (pp. 443–478). LIT Verlag, Munster.
[9] Rodrik, Dani. (2004). *Getting Institutions Right*. Harvard University, Mimeo.

E. Kobal and S. Radosevic (Eds.)
IOS Press, 2005

Author Index

This page intentionally left blank